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Determination of the Suitability of Arkansas River Water for Municipal, Industrial and Agricultural Use: Volume 2A Water Quality Data

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DETERMINATION OF THE SUITABILITY OF ARKANSAS RIVER WATER FOR MUNICIPAL, INDUSTRIAL AND AGRICULTURAL USE

- VOLUME TWO A -
- WATER QUALITY DATA -

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INTRODUCTION

Volume II of the overall report for the project to determine the suitability of the Arkansas River for municipal, agricultural and industrial water supplies contains additional water quality information. This information includes the historical evaluation of the water quality in the Arkansas River and data for various water quality parameters included in the two-year sampling program.

The research project was conducted under contract with the Arkansas Soil and Water Conservation Commission. Funding was provided by the Corps of Engineers, the Environmental Protection Agency, the City of Little Rock, Rockefeller Foundation and the Ozark Society. Additionally, the U. S. Geological Survey contributed financially by matching the cost of sample collection. The City of Little Rock provided funding for sampling the Little Rock site. Funding for the Lee Creek site was provided by the Environmental Protection Agency.

The overall project to determine the suitability of Arkansas River water for agricultural, municipal and industrial water supplies encompassed five major topical areas. These were: 1) a review of the historical water quality data available on the river, 2) initiation and completion of a sampling program, 3) bench-scale treatability studies on the river water, 4) evaluation of the water quality data with

respect to municipal, agricultural and industrial water supply needs, and; 5) an economic evaluation of treatment costs for the several potential uses of the river as a water supply source.

The sampling program included five sites. These were Van Buren, Dardanelle, Little Rock and Pine Bluff on the main stem of the river and a site on Lee Creek upstream from its confluence with the Arkansas River. The study, as originally funded, included three sites. These were the Van Buren, Dardanelle and Pine Bluff sites. Sampling was commenced in August, 1987 for these sites and was completed in July, 1989. Sampling at the Little Rock site was initiated in June, 1988 and was completed in July, 1989. The sampling program for the Lee Creek site extended from August, 1988 until July, 1989.

Analyses on the samples at all five sites included various wet chemistry, atomic absorption and organics analyses. The wet chemistry and atomic absorption analyses were conducted at the University of Arkansas. The "organics" analyses were conducted by private laboratories. The term "organics" is used to describe the pesticide/PCB, semivolatile organic chemicals and volatile organic chemicals for which results are produced using Methods 508, 524 and 525 and Methods 608, 624 and 625. Two private laboratories were utilized for the organics analyses. These were American Interplex in Little Rock and Daily Analytical Services in Peoria, Illinois. Both laboratories are certified.

Chapter II

HISTORICAL DATA REVIEW

Because of space limitations, the results of the historical evaluation included in Volume I was limited. Additional information is included in this volume. The focus of the historical review was twofold. The first purpose of the review was to provide information for framing the two-year sampling program. The second purpose was to identify any changes in water quality which have occurred as a function of time. It is the latter purpose for which the results of the review are presented in this chapter.

All data available for sampling sites on the main stem of the Arkansas River from its confluence with the Mississippi River to Dodge City, Kansas were supplied by the U.S. Geological Survey. Additionally, data for several of the tributaries in Kansas and Oklahoma were supplied by the U.S. Geological Survey. These data were used to develop a series of graphs principally showing the parameter concentrations as a function of time. The results of the review for those sites in Arkansas are included in this chapter. These include the eleven existing sites in Arkansas for which the data were available.

The eleven sites include Van Buren (Mile 316.5), Van Buren-Lock and Dam 13 (Mile 308.9), Ozark Dam (Mile 272.9), Dardanelle (Mile 219.5), Toad Suck Ferry Dam near Conway (Mile 172.0), Murray Dam at Little Rock (Mile 141.5), David D. Terry Lock and Dam below Little Rock (Mile 124.2), Lock

and Dam 5 near Wright, Lock and Dam 4 near Pine Bluff, and Dam No. 2 near Gillett.

Additionally, some data exists for several discontinued sites on the Arkansas River. These are at Ozark, Lake Dardanelle, Little Rock, Pine Bluff, Lock and Dam 3 near Swan Lake and Pendleton. The discontinued sites are included as appropriate. There are substantial variations in the lengths of the periods of record for these sites and in the beginning and ending dates of the records. Consequently, more emphasis was placed on those sites for which longer periods of record existed. The historical data evaluation was highlighted for the Van Buren site because of the long period of record and because it can be considered to be generally representative of the water quality of the river water as it enters Arkansas. The data for the eleven existing sites are presented in the order of upstream to downstream location.

Van Buren

The Van Buren sampling site is near the left bank of the river on the upstream side of the bridge on U. S. Highway 64 and 71 at Van Buren, 1.4 miles downstream from Lee Creek, 8.7 miles downstream from the Poteau River, at mile 316.5. The period of record is from October, 1945 to September, 1970 and from April, 1974 until the current year.

Data are available for a variety of parameters including alkalinity, chloride, coliform, dissolved solids, endrin, lindane, pH, potassium, sodium, total hardness, toxaphene, turbidity, 2,4,5-T and 2,4-D. Some data are also available

for cadmium, chromium, copper, lead, zinc, nitrogen and phosphorous.

Alkalinity. The alkalinity data for the Van Buren site are shown graphically in Figures 1 through 10. Figures 1 through 8 show the data plotted with two, three or four year periods to allow examination with respect to seasonal cycles which might be present. Figures 9 and 10 show all data from 1945 until 1969 and from 1974 until 1986, respectively. The average alkalinity concentration from 1945 until 1971 was 103 mg/L. The average concentration for the period from 1974 until 1986 was 94 mg/L. The data in Figure 7 are plotted with an expanded scale because of three unusually large alkalinity concentrations. These concentrations were 703, 1,280 and 884 mg/L and occurred during a three day period in 1961. All remaining concentrations were well below 250 mg/L.

Chloride. The chloride data for the Van Buren site are shown in Figures 11 through 33. Figures 11 through 19 show the chloride data plotted on short-term cycles to show seasonal tendencies. Figure 20 shows all data from 1945 until 1969. Both chloride and flow are plotted as a function of time in Figure 21. The average chloride concentration from 1945 until 1969 was 310 mg/L. The data ranged from 15 to 3,000 mg/L. The average chloride concentration for the data from 1969 until 1986 was 179 mg/L. The chloride concentrations for this period ranged from 12 to 428 mg/L.

Figures 22 through 30 show the chloride at the Van Buren site in tons per day. The average was about 12,500 tons per

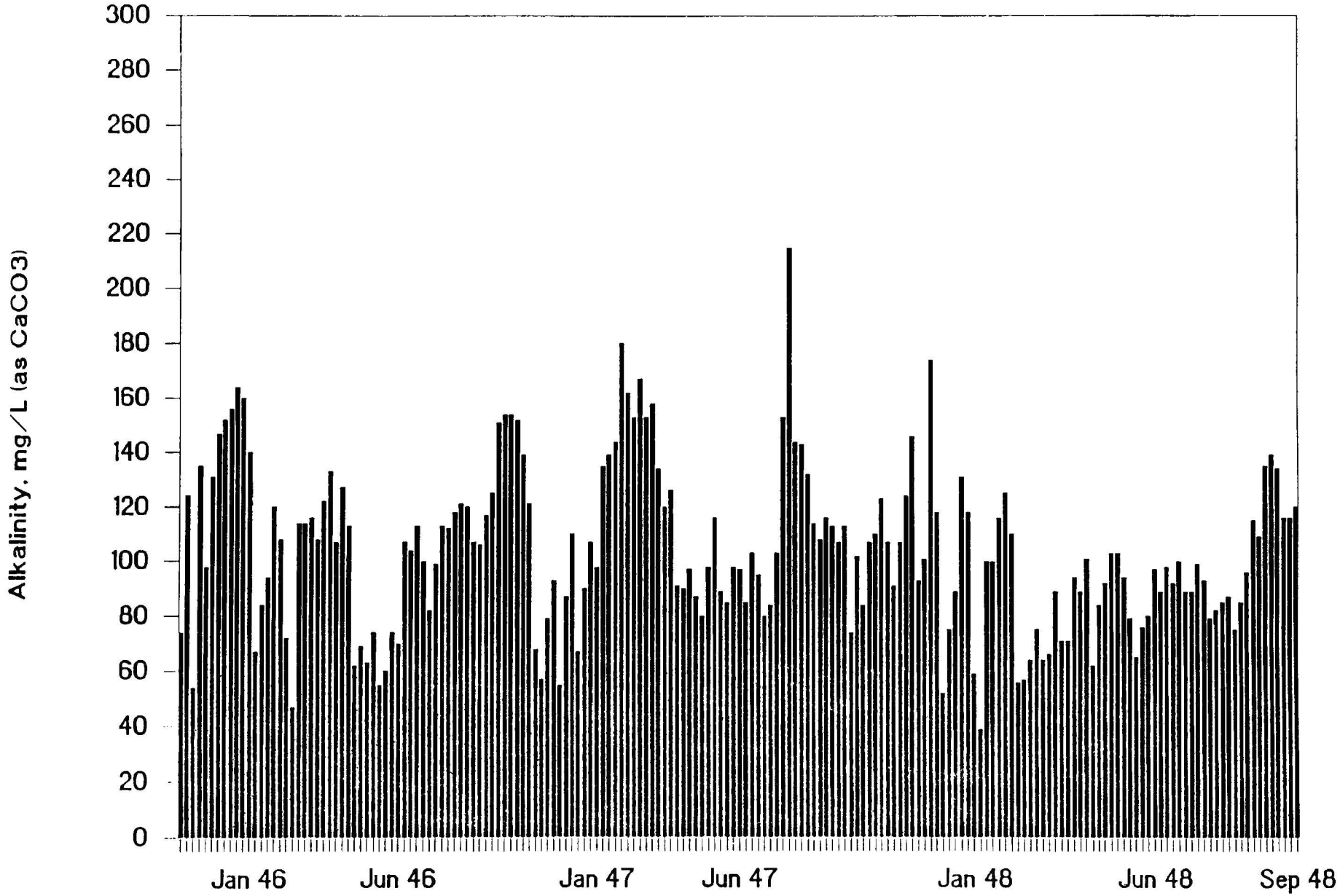


Figure 1. Graph Of Alkalinity Versus Time For The Van Buren Site 1945-1948.

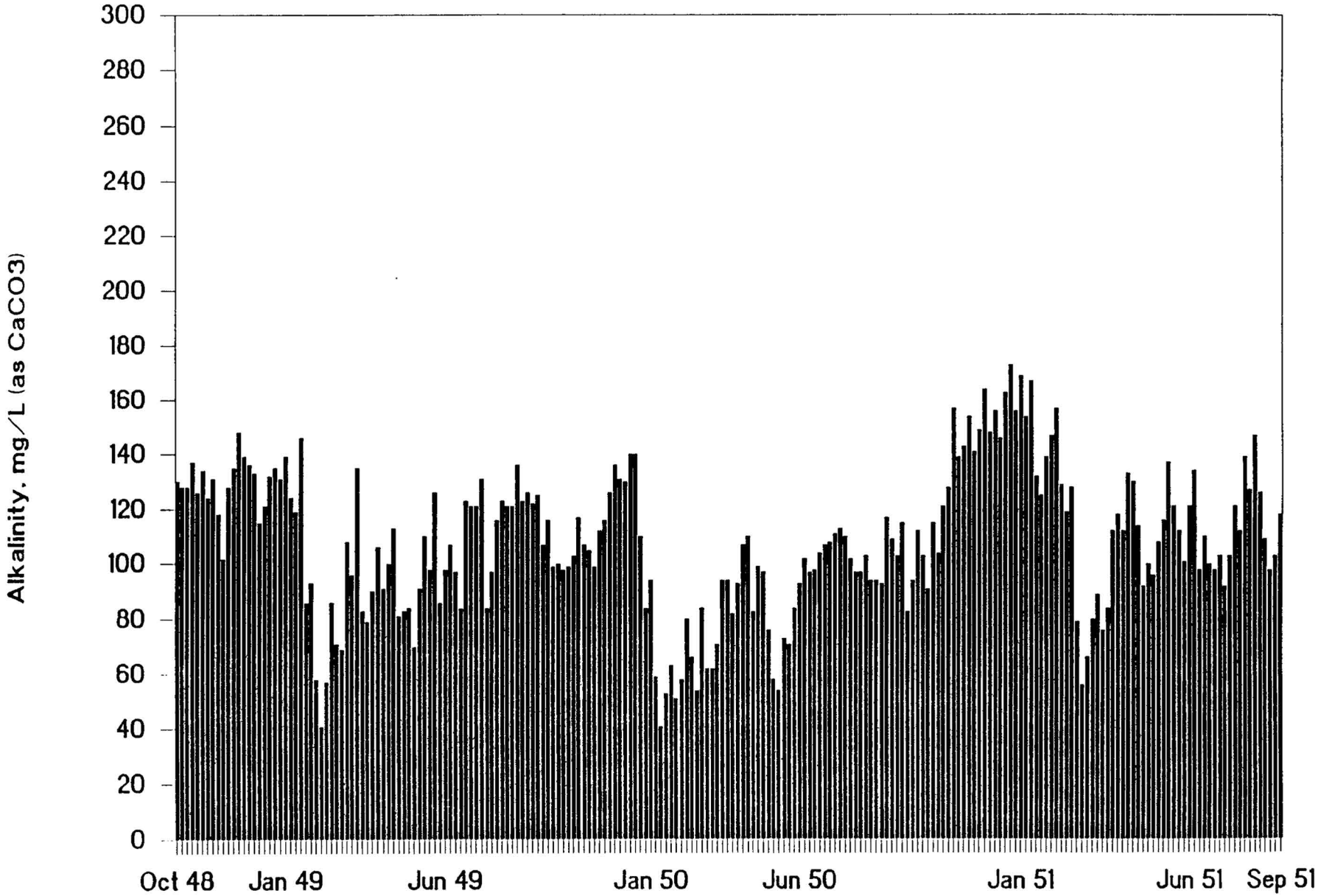


Figure 2. Graph Of Alkalinity Versus Time For The Van Buren Site 1948-1951.

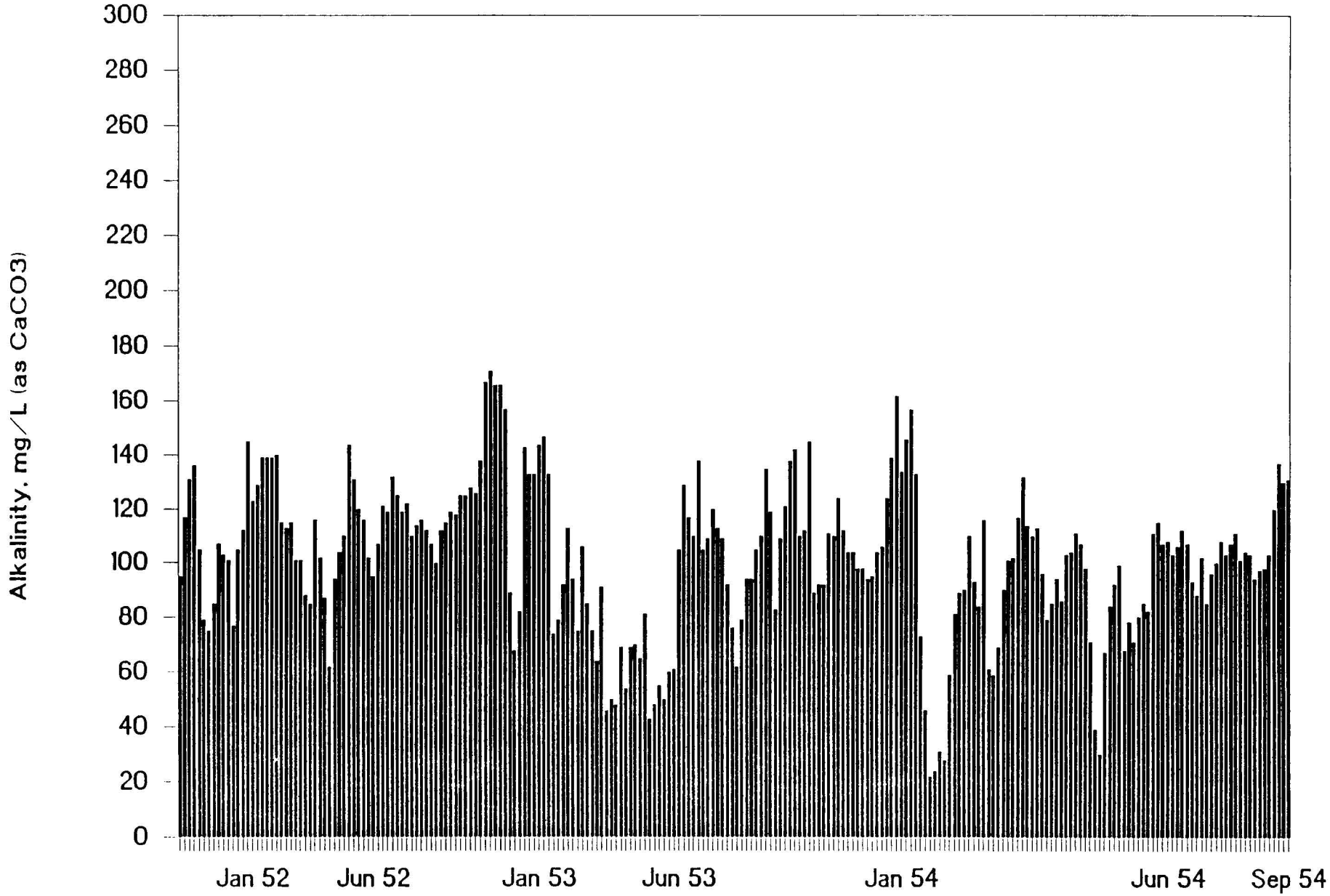


Figure 3. Graph Of Alkalinity Versus Time For The Van Buren Site 1951-1954.

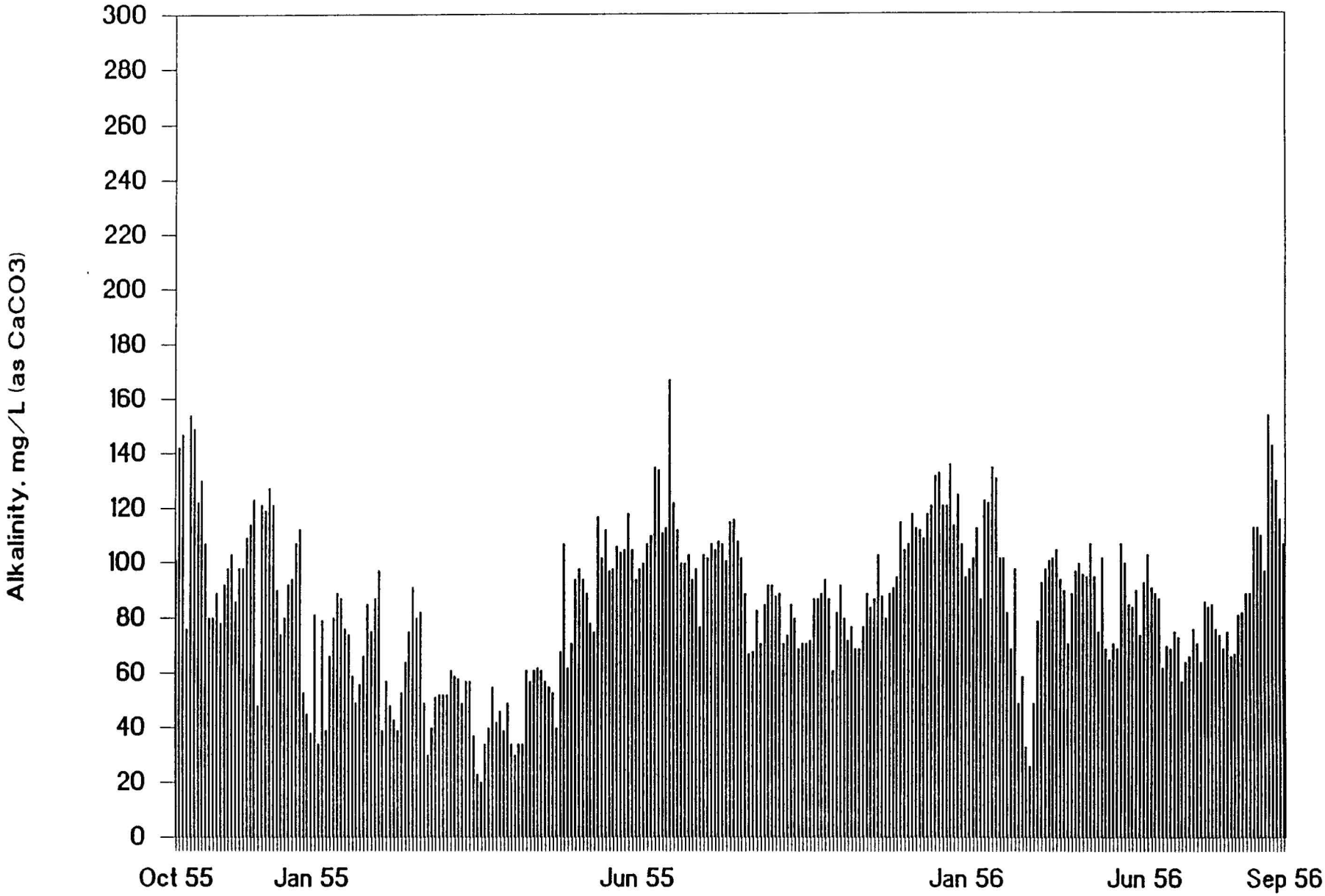


Figure 4. Graph Of Alkalinity Versus Time For The Van Buren Site 1954-1956.

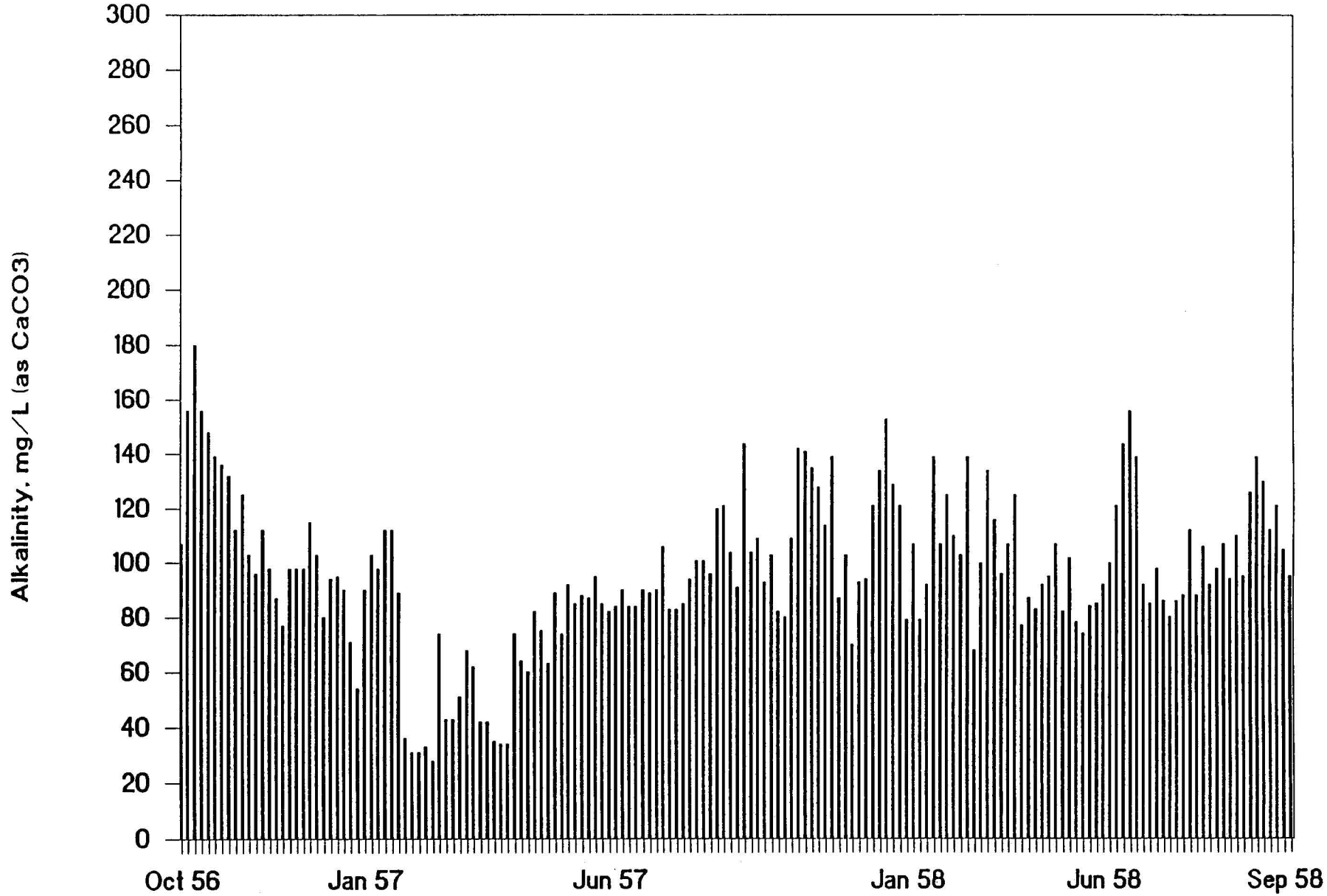


Figure 5. Graph Of Alkalinity Versus Time For The Van Buren Site 1956-1958.

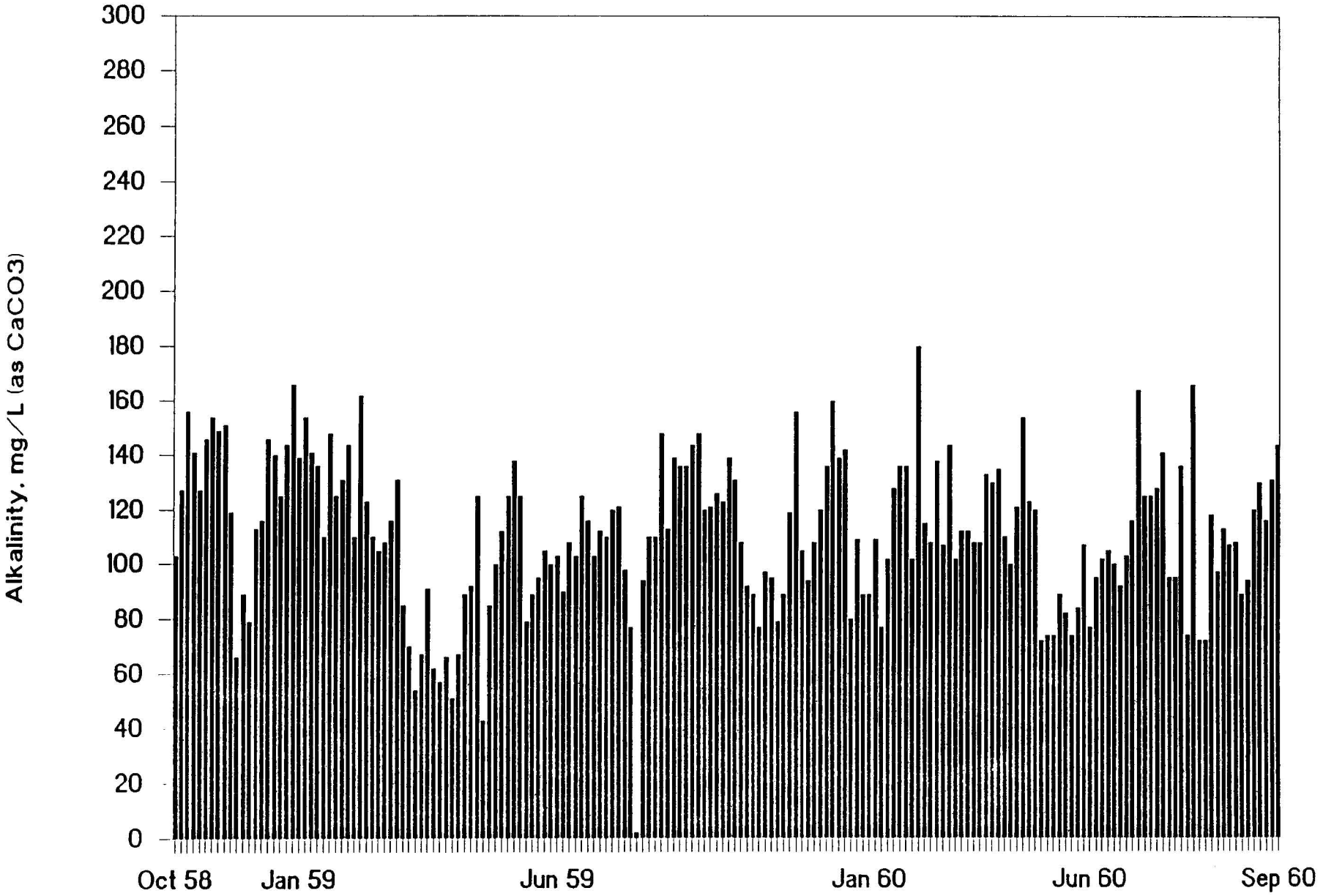


Figure 6. Graph Of Alkalinity Versus Time For The Van Buren Site 1958-1960.

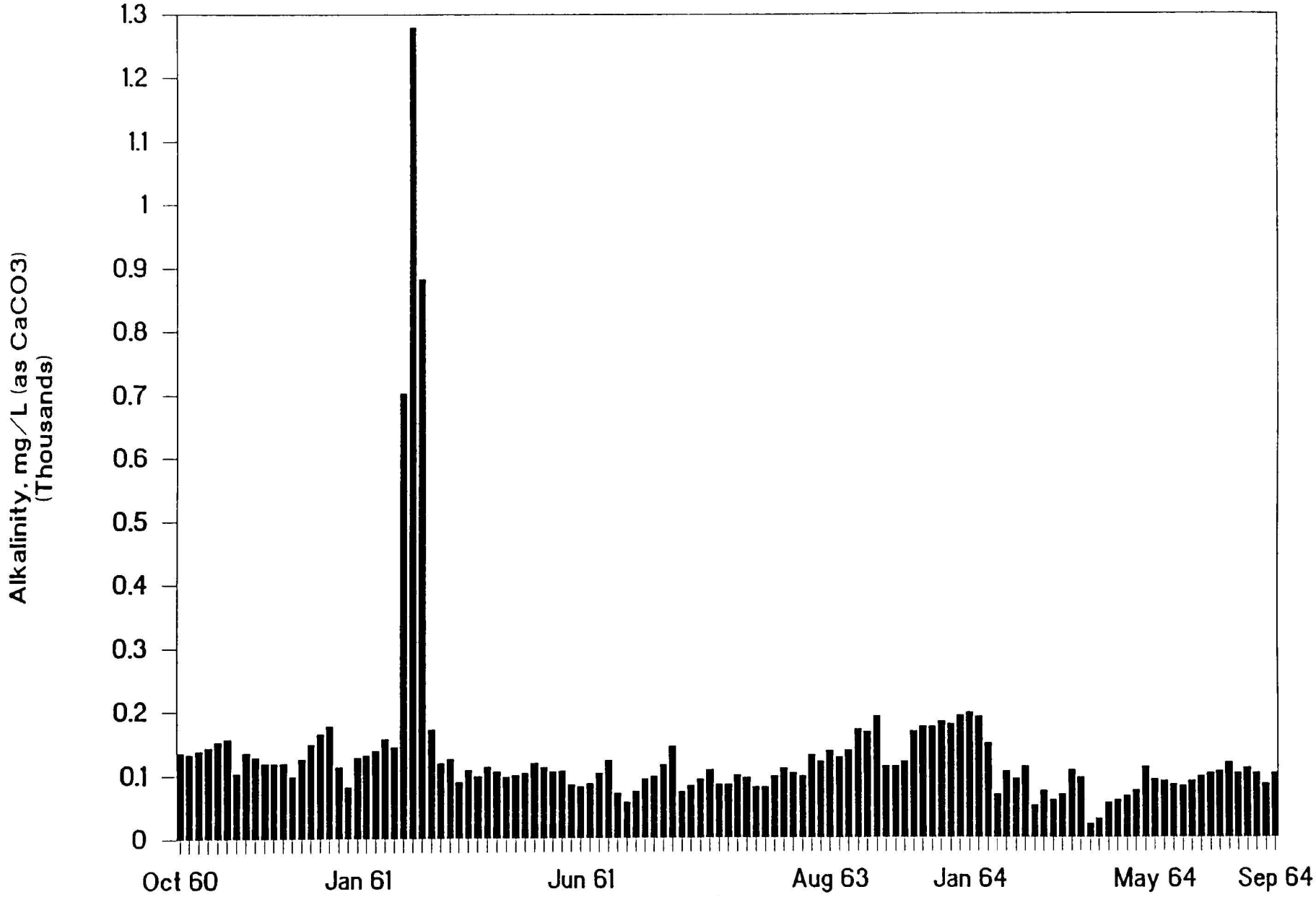
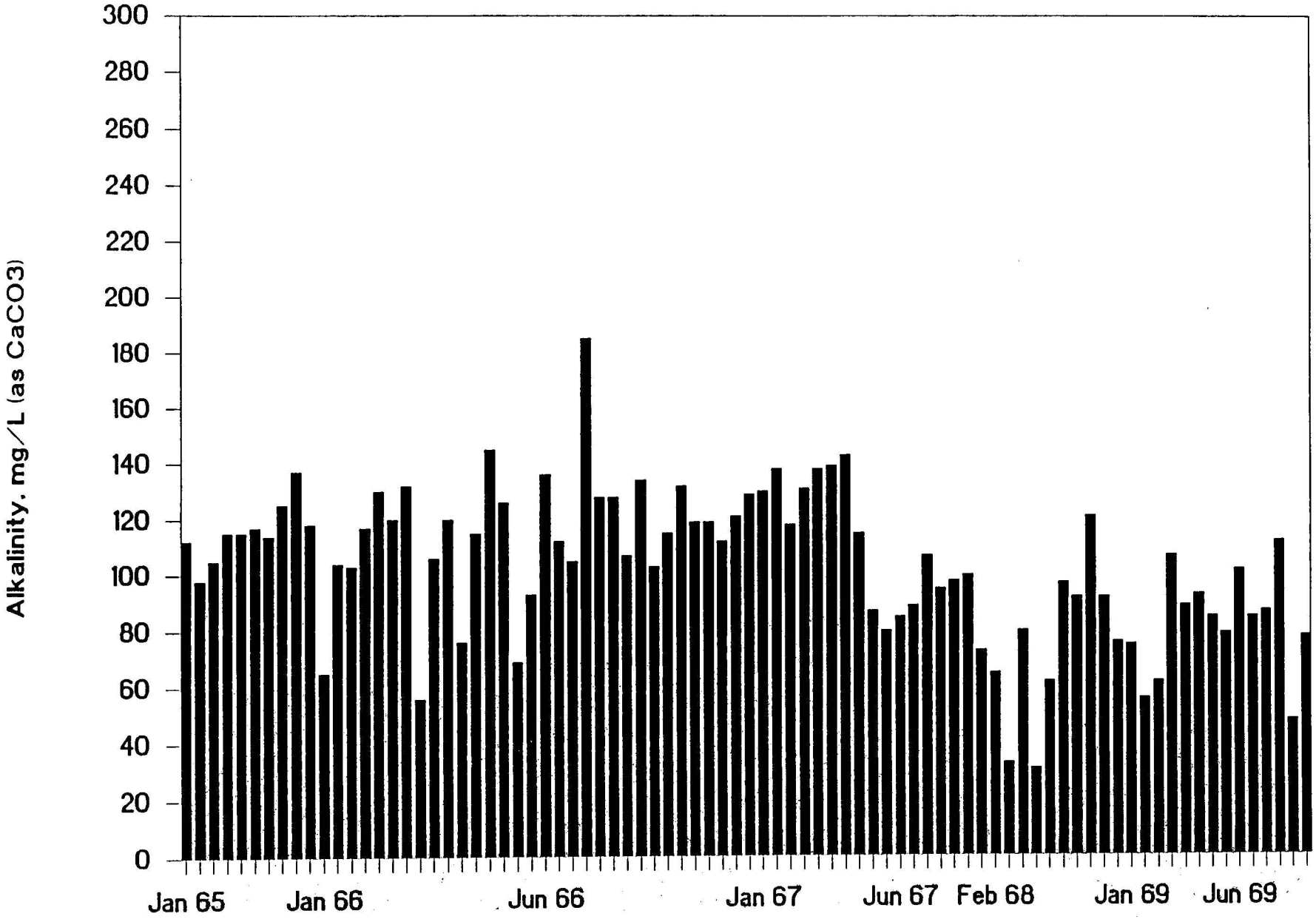


Figure 7. Graph Of Alkalinity Versus Time For The Van Buren Site 1960-1964.



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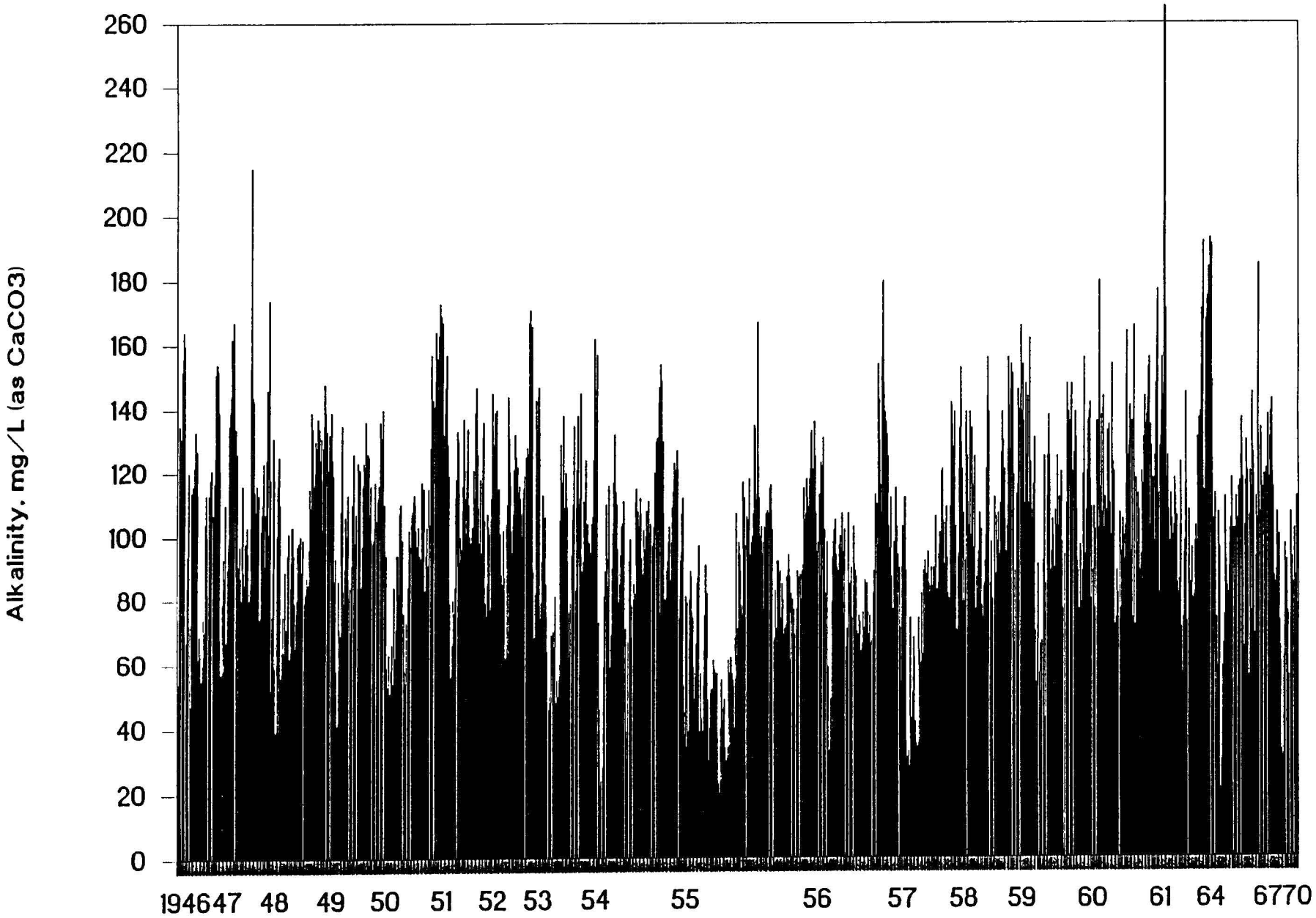

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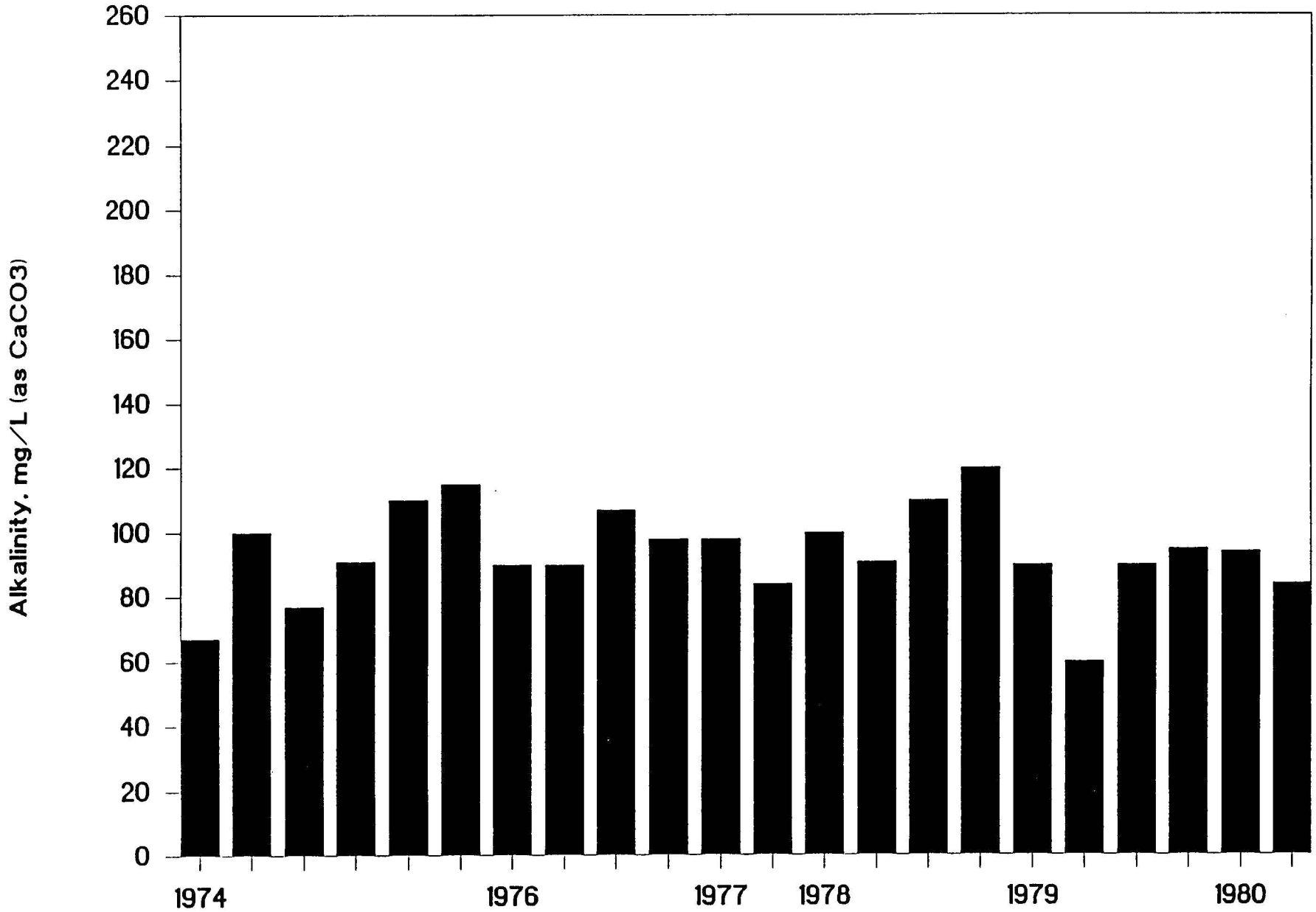

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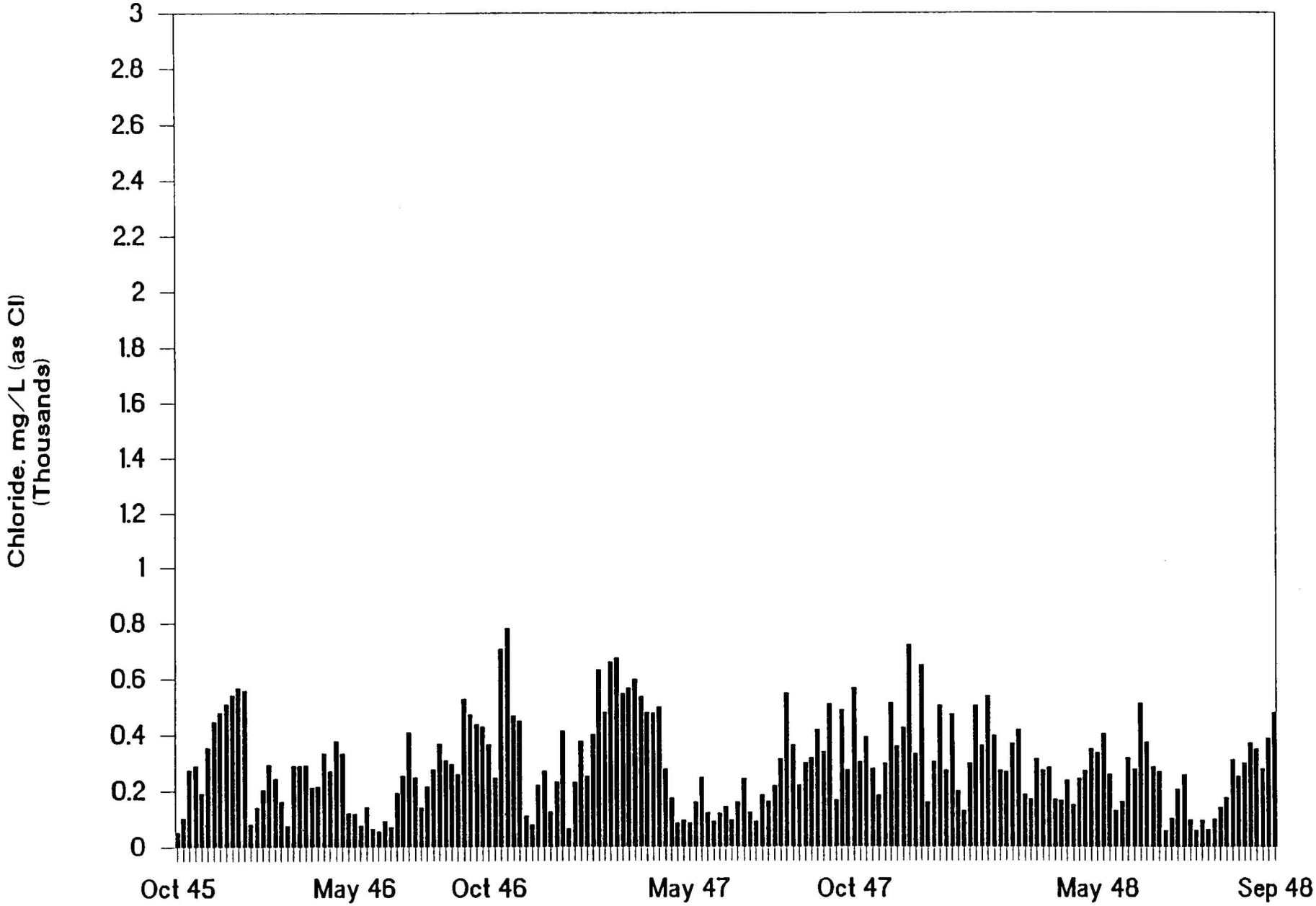


Figure 11. Graph Of Chloride Versus Time For The Van Buren Site 1945-1948.

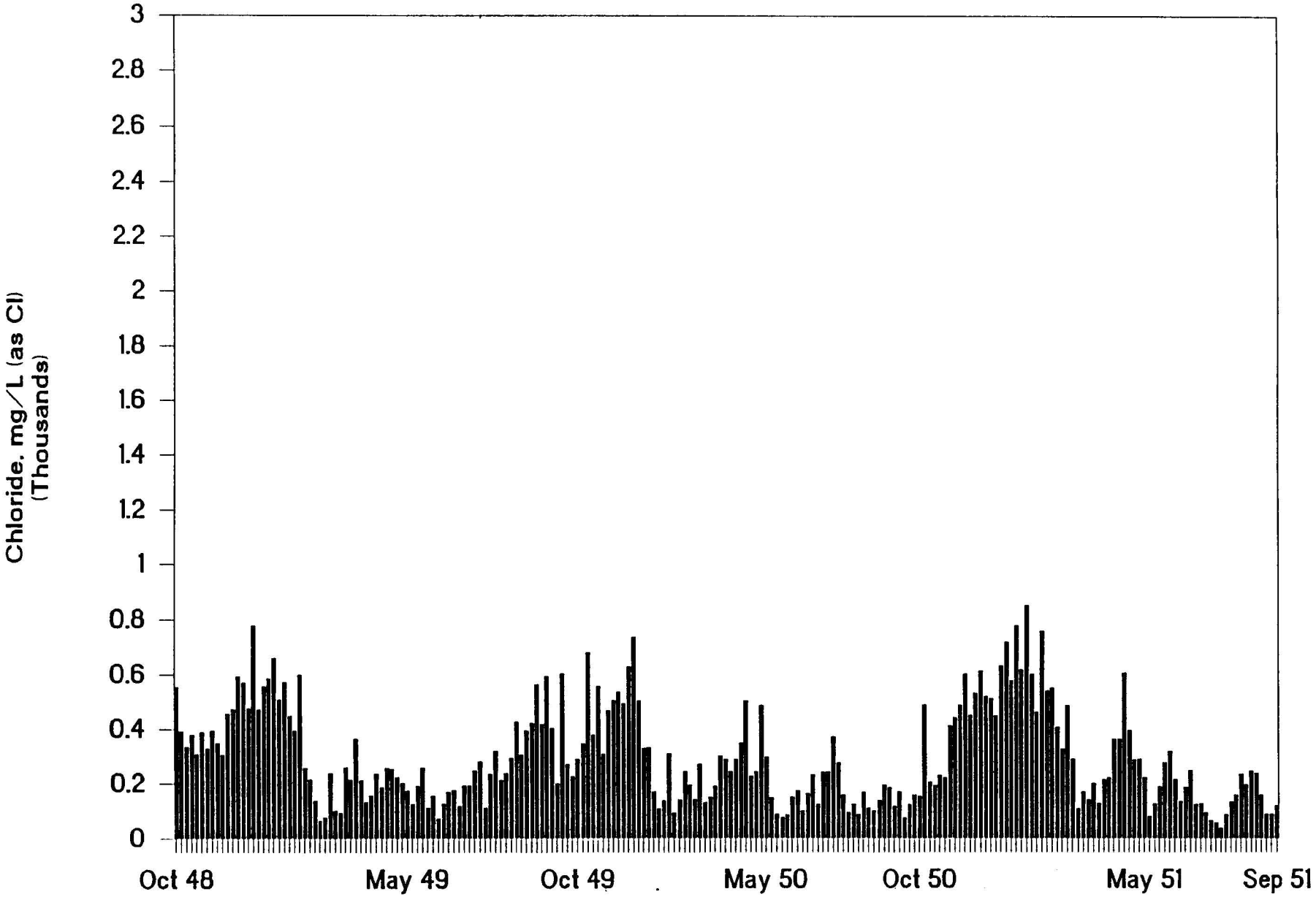
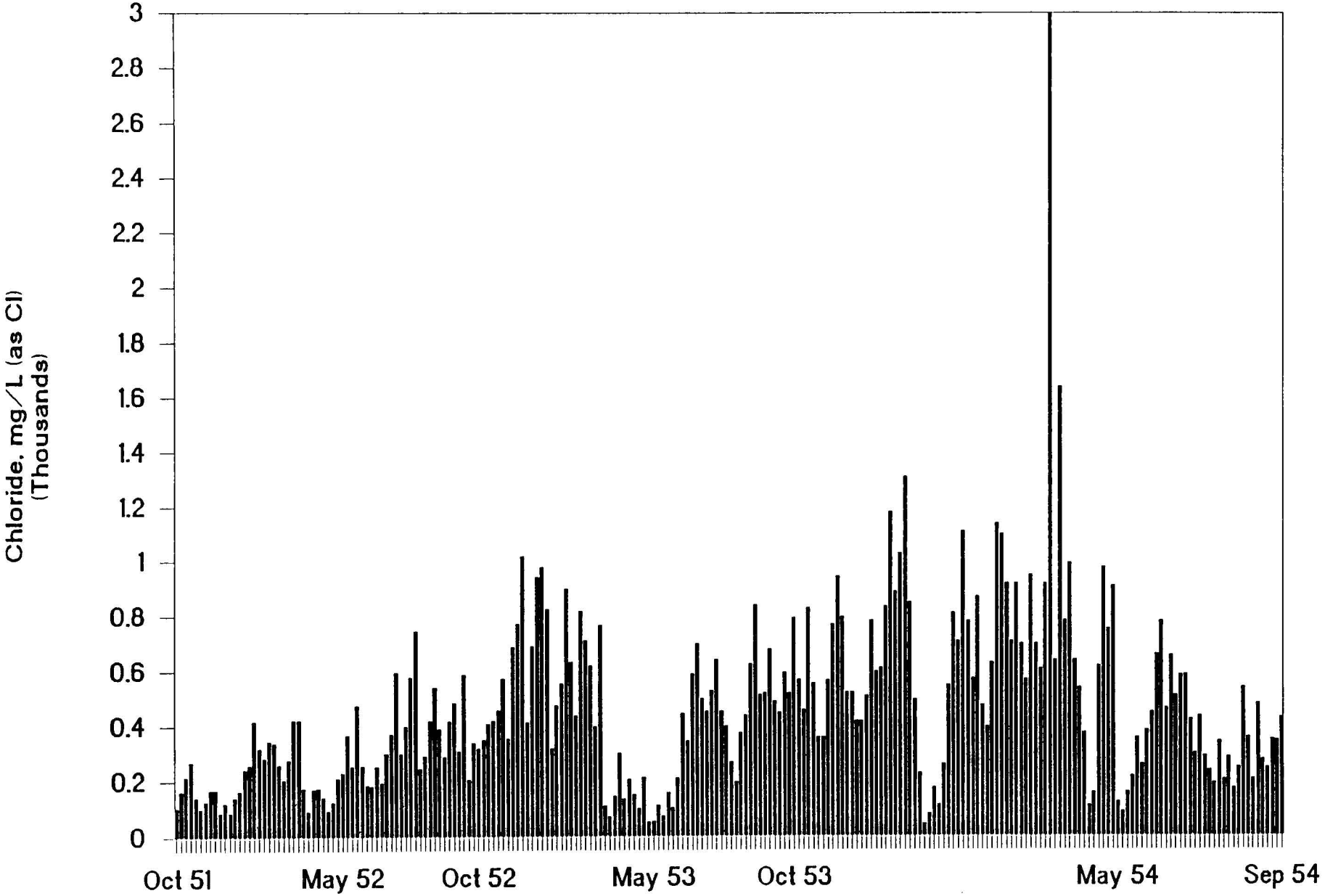


Figure 12. Graph Of Chloride Versus Time For The Van Buren Site 1948-1951.



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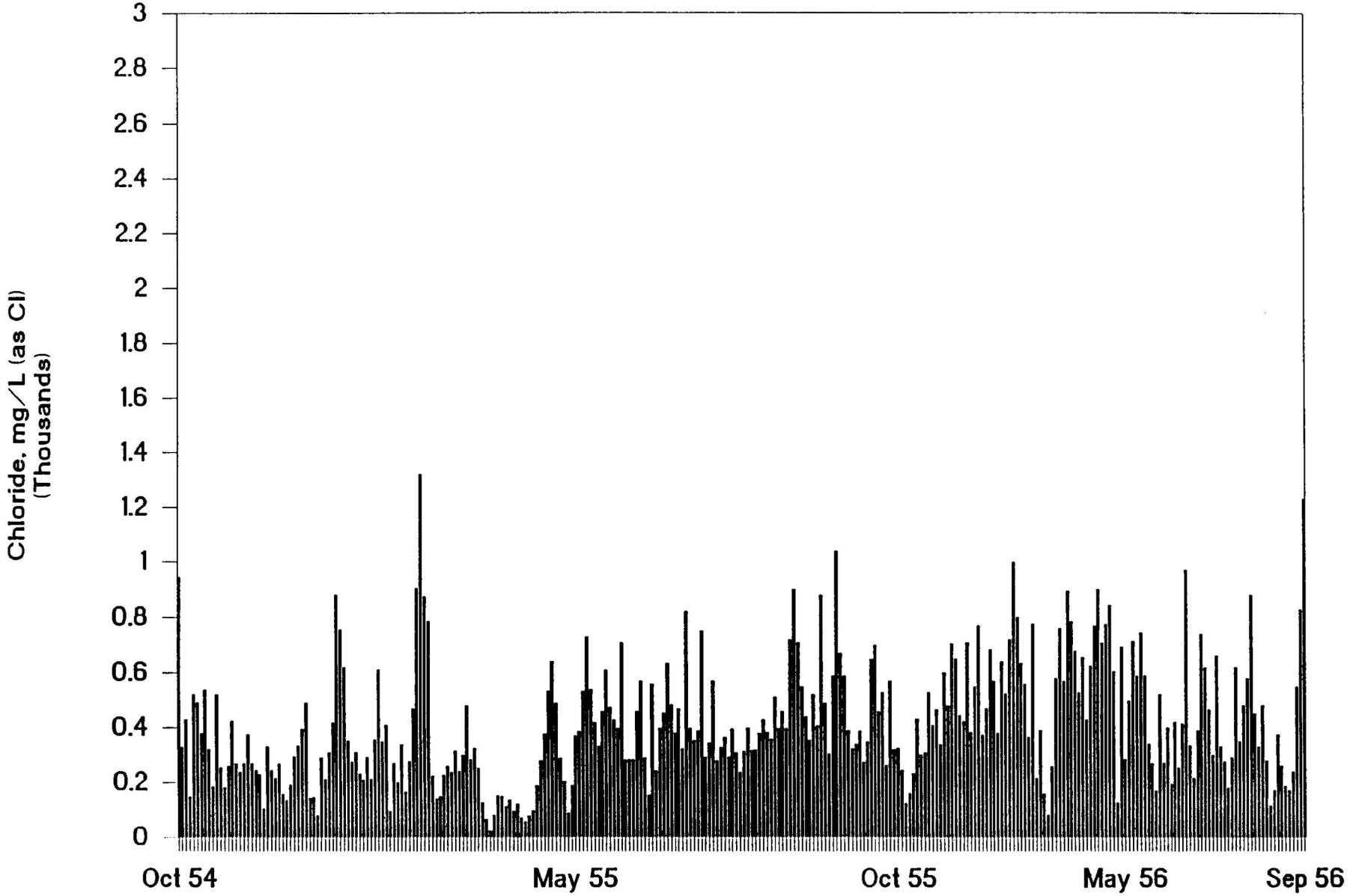

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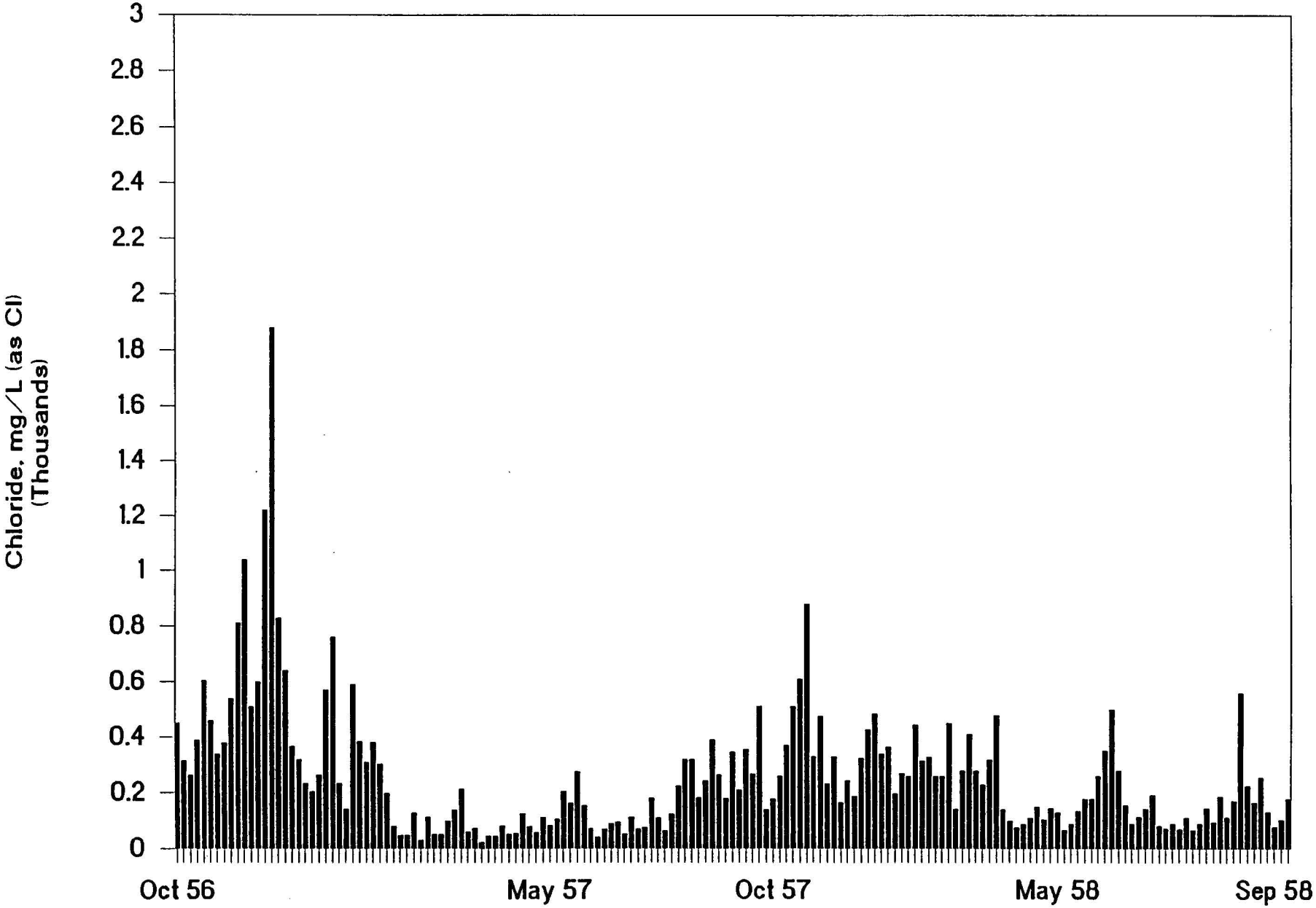

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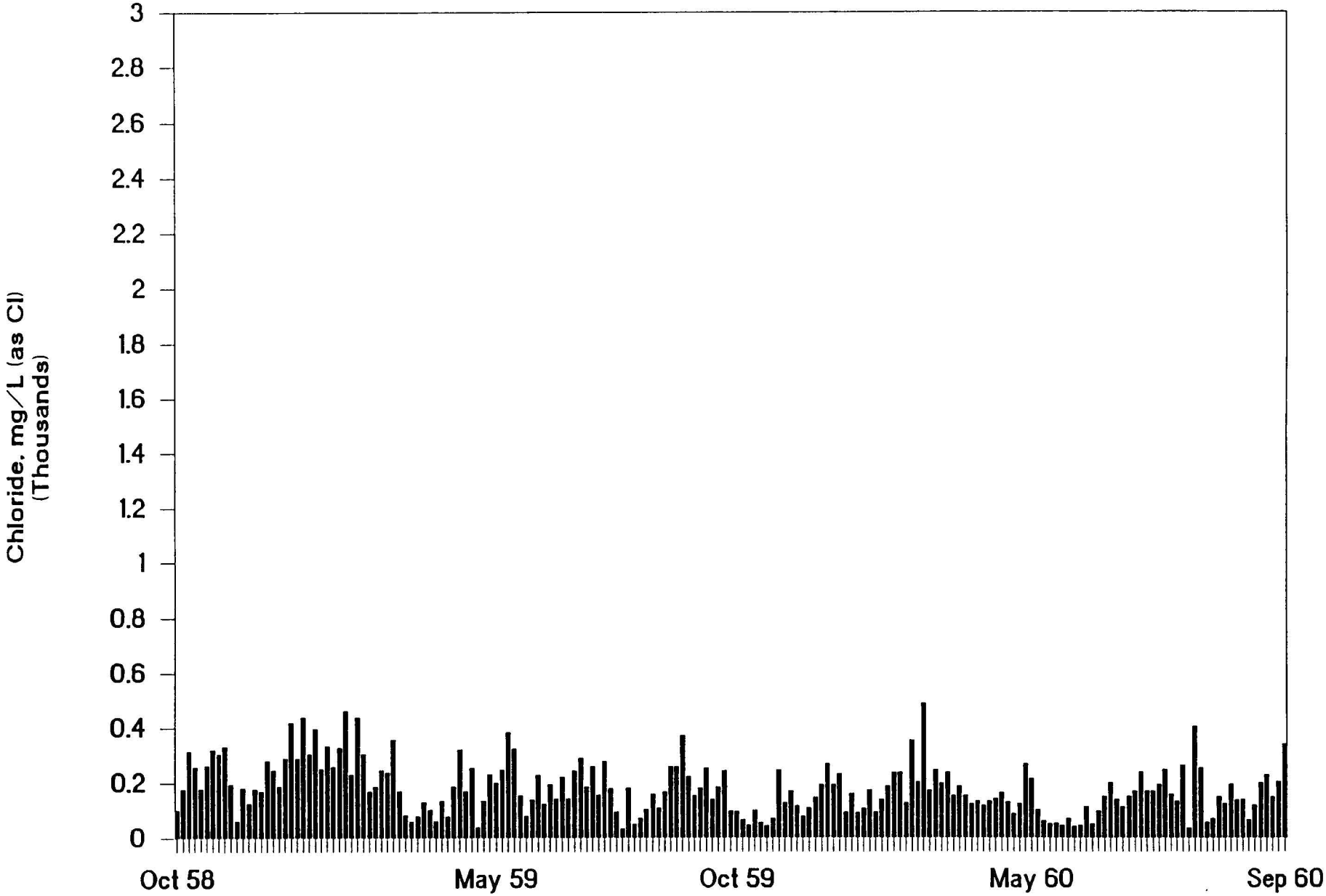

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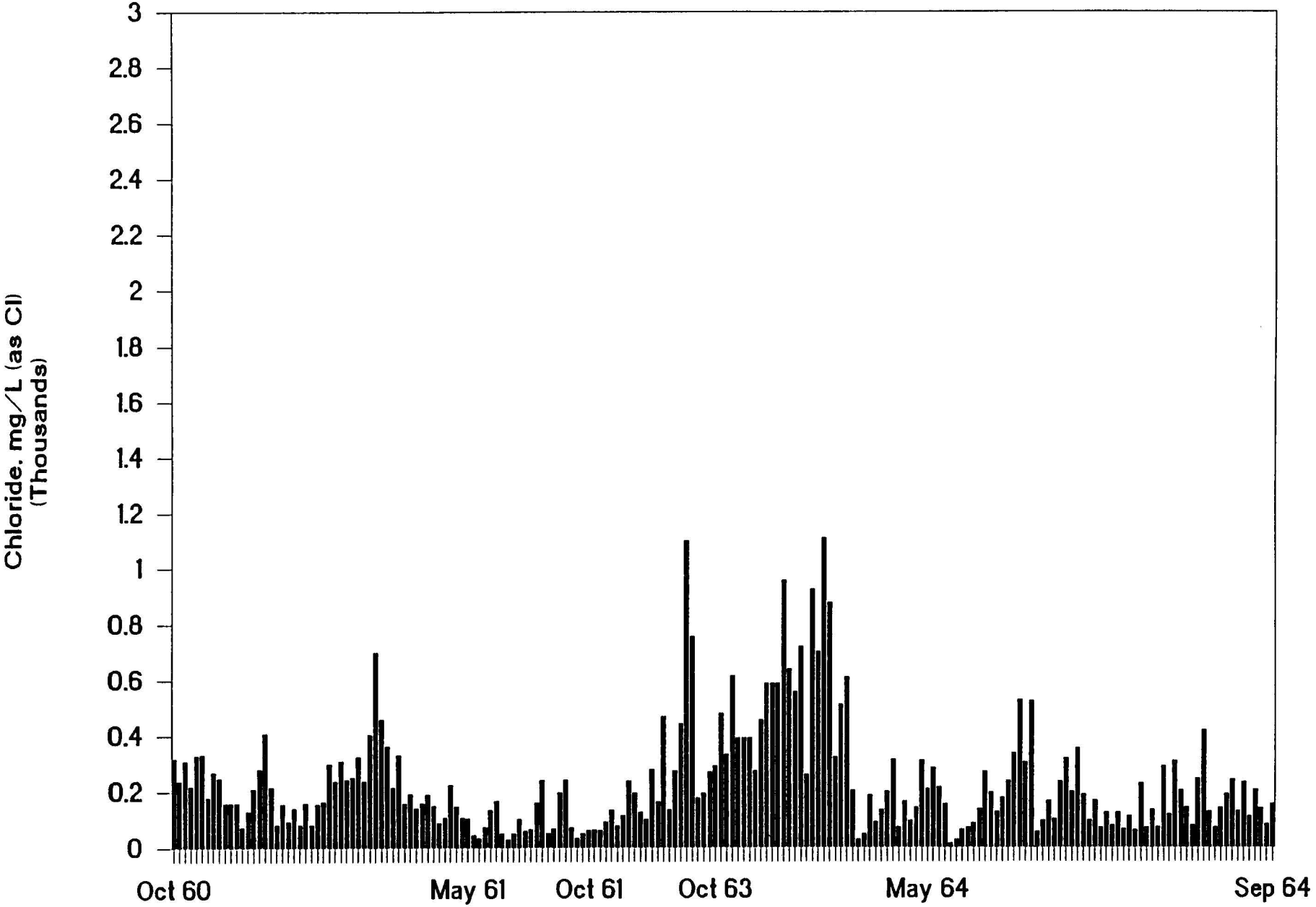

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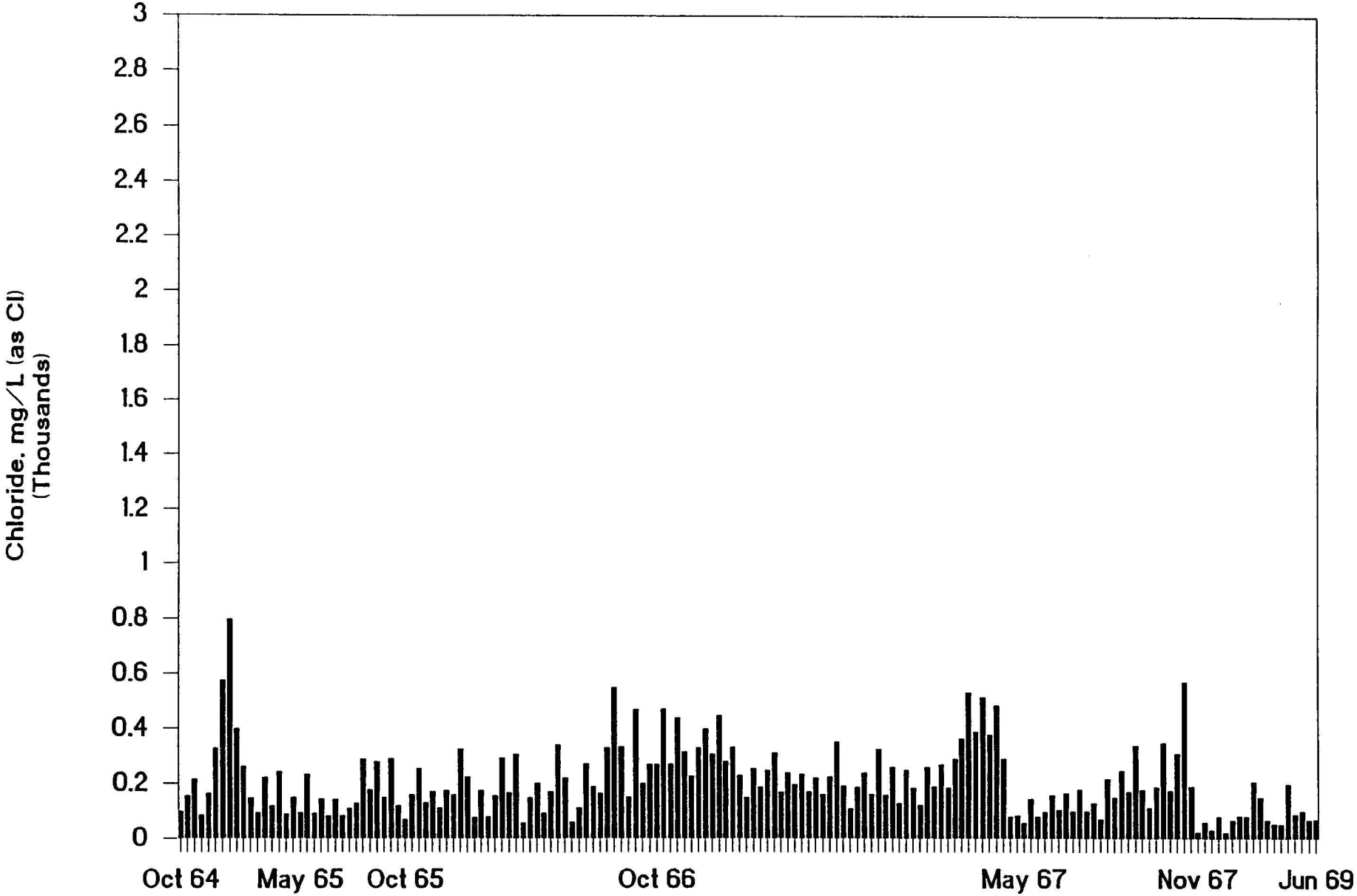

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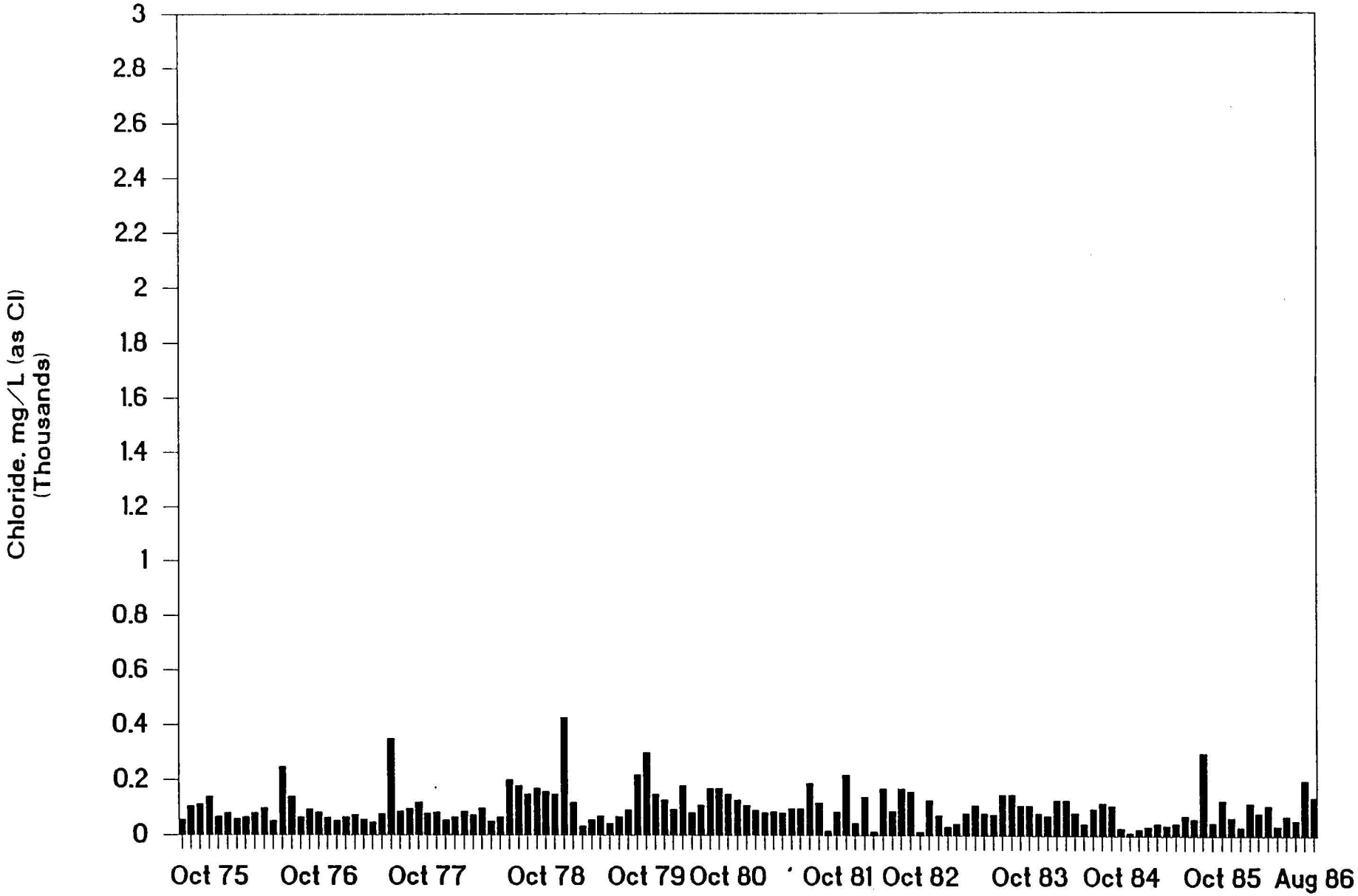


Figure 19. Graph Of Chloride Versus Time For The Van Buren Site 1974-1986.

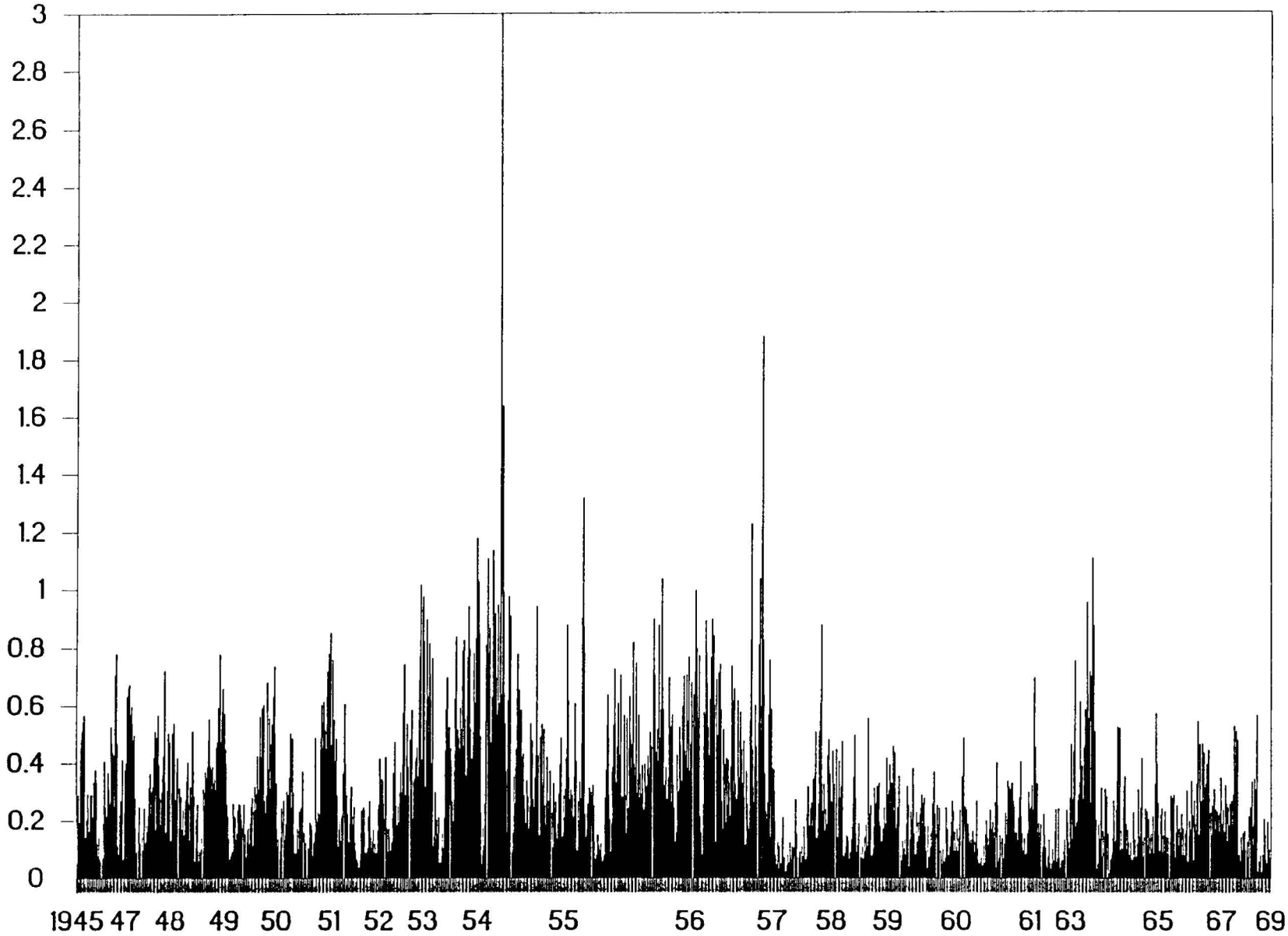
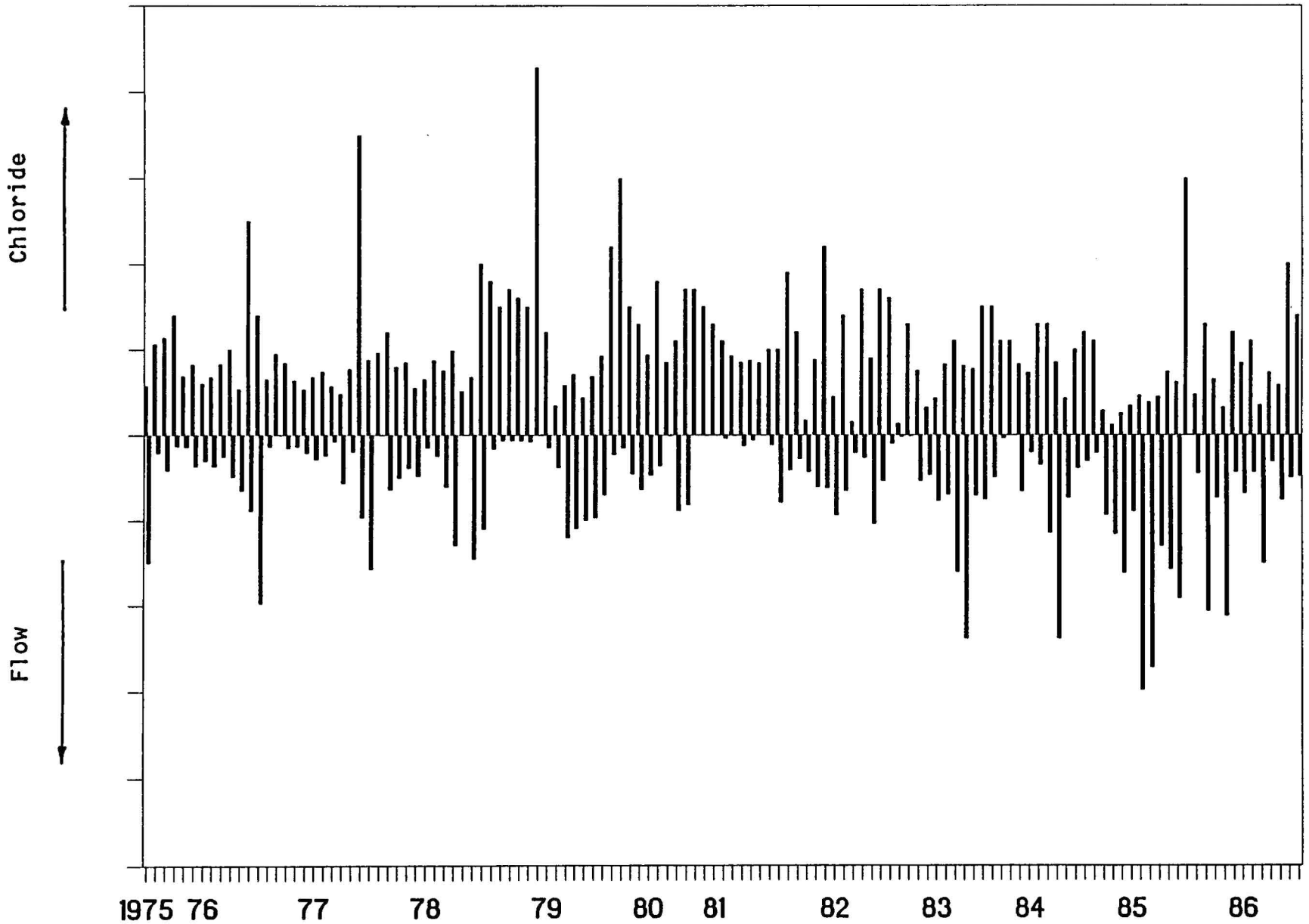


Figure 20. Graph Of Chloride Versus Time For The Van Buren Site 1945-1969.



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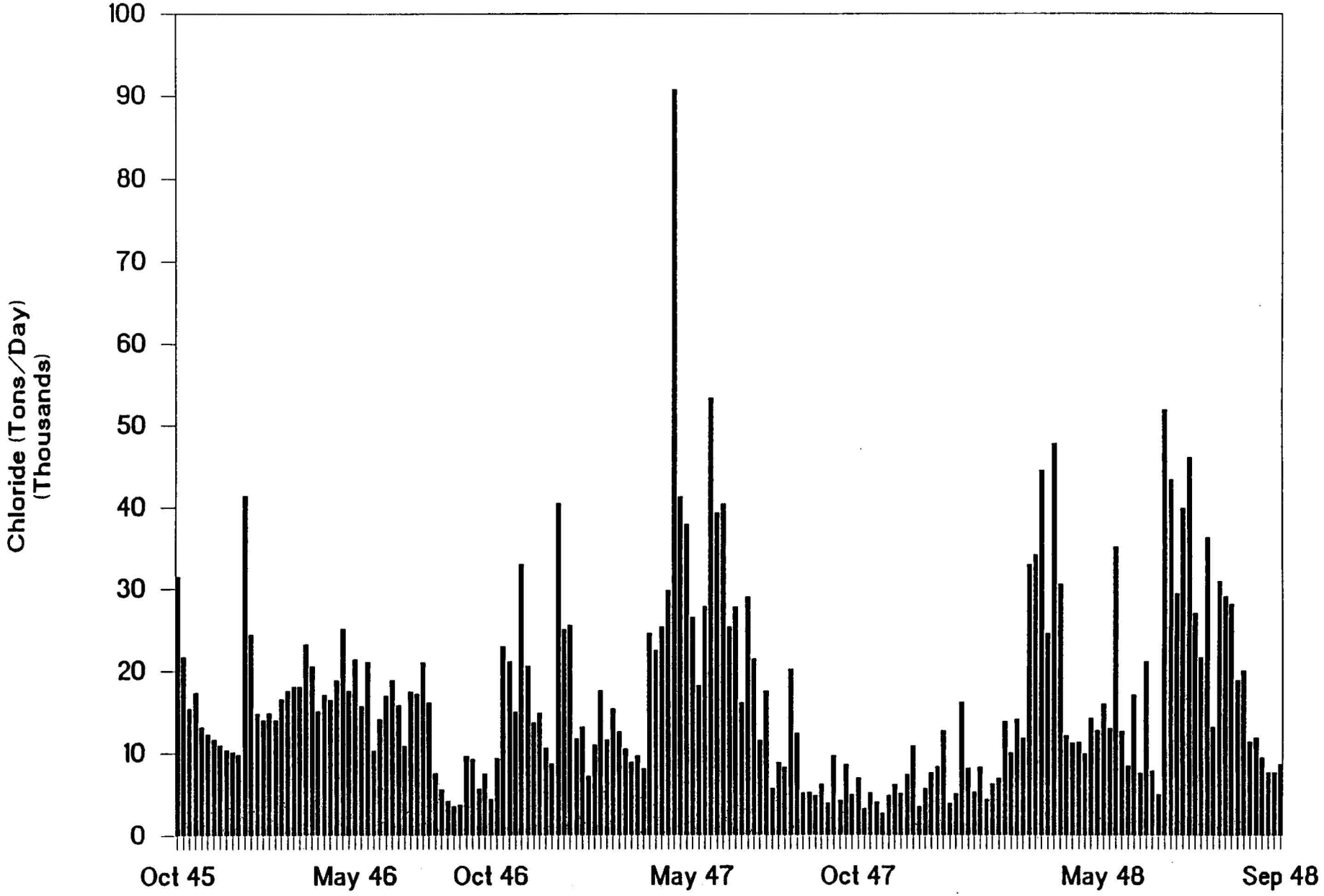

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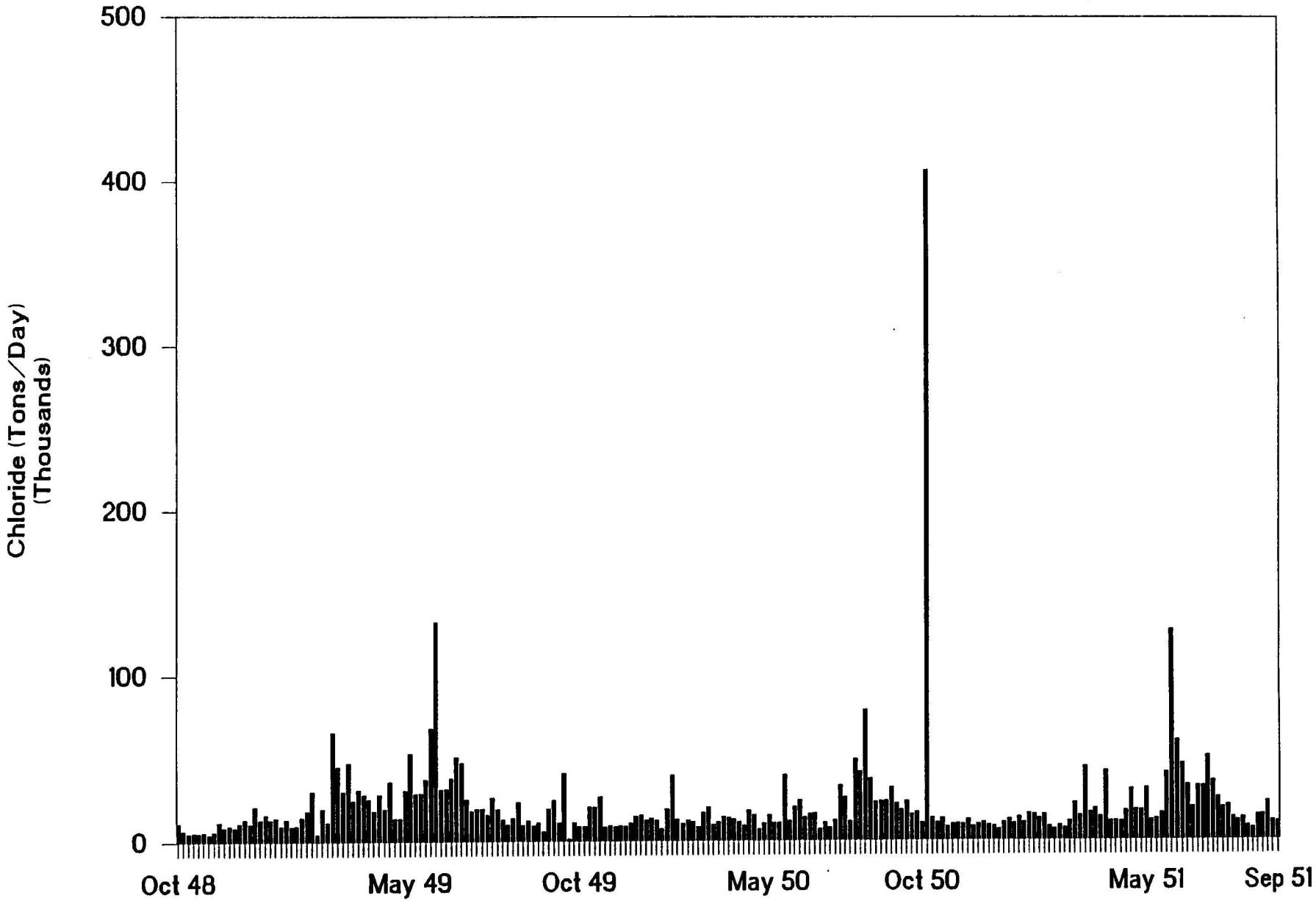

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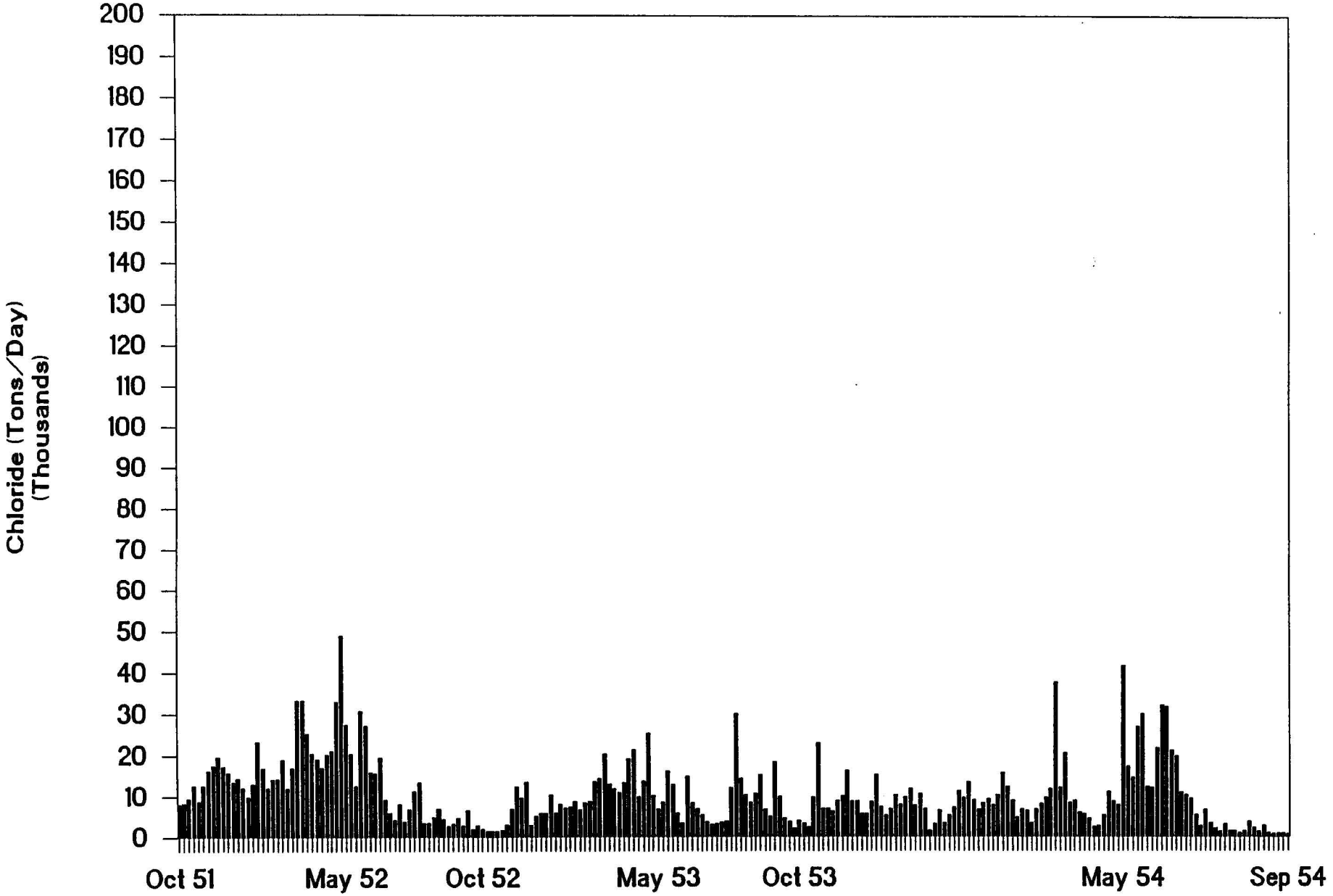

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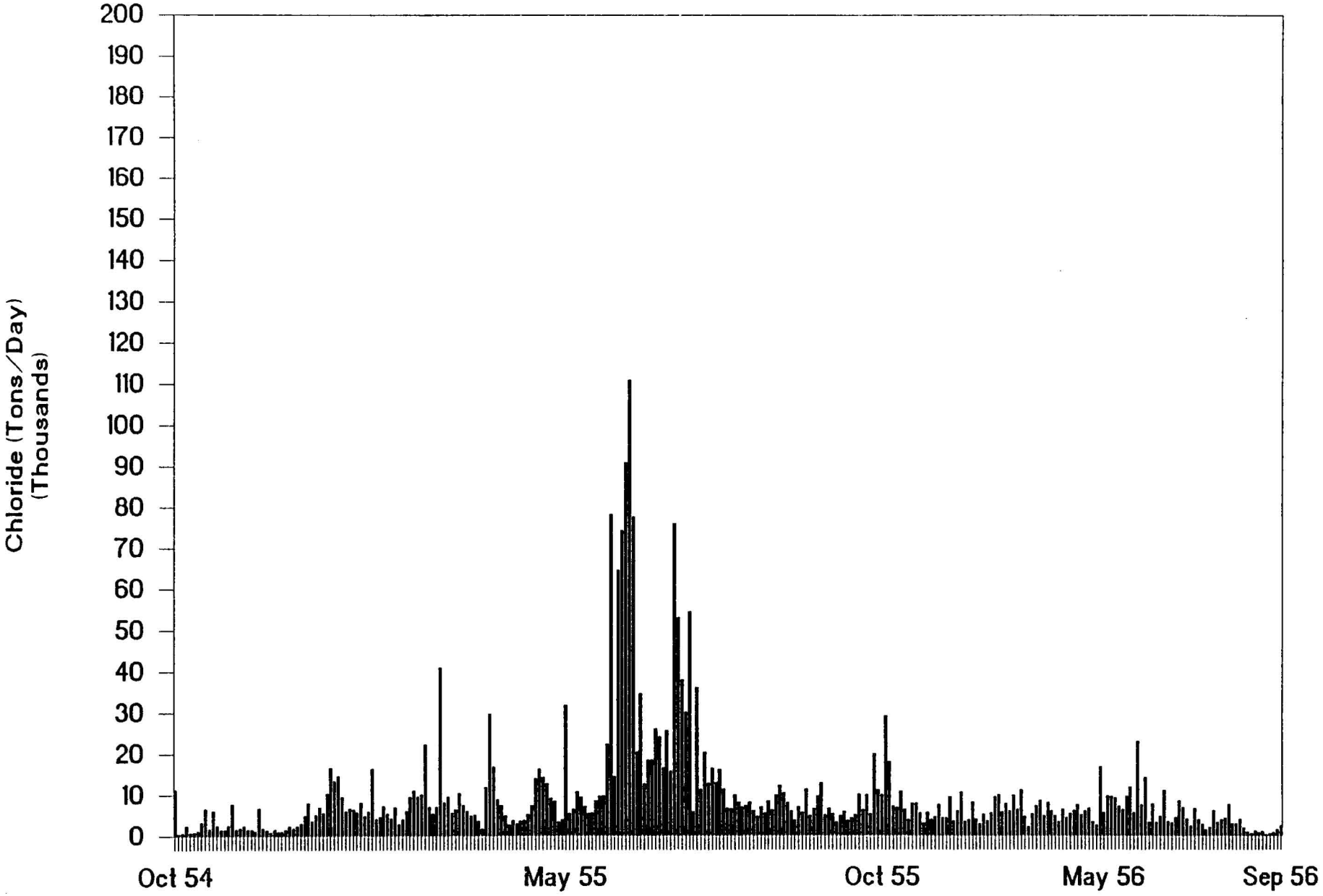

Figure 25. Graph Of Chloride (Tons per Day) Versus Time For The Van Buren Site 1954-1956.

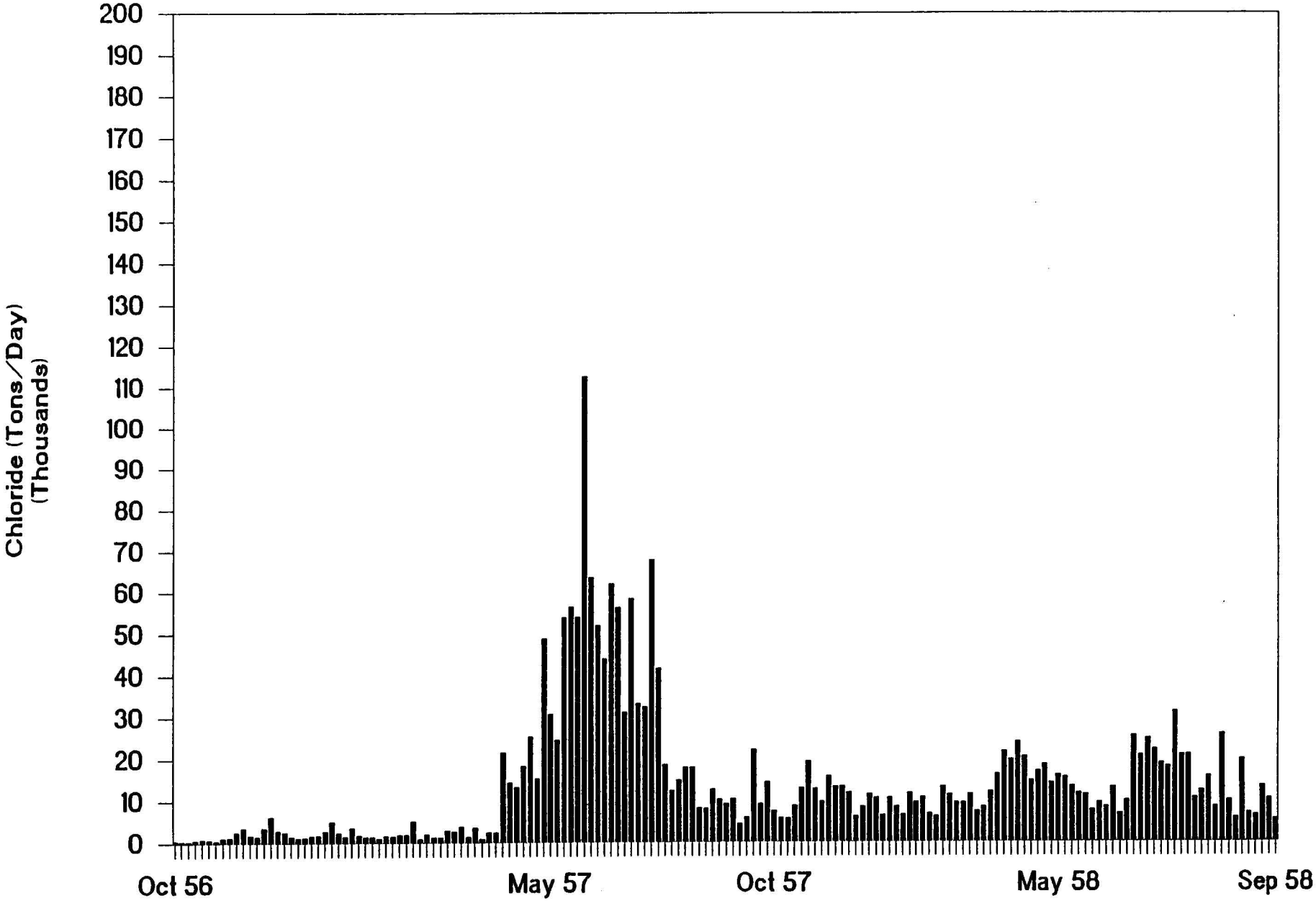

Figure 26. Graph Of Chloride (Tons per Day) Versus Time For The Van Buren Site 1956-1958.

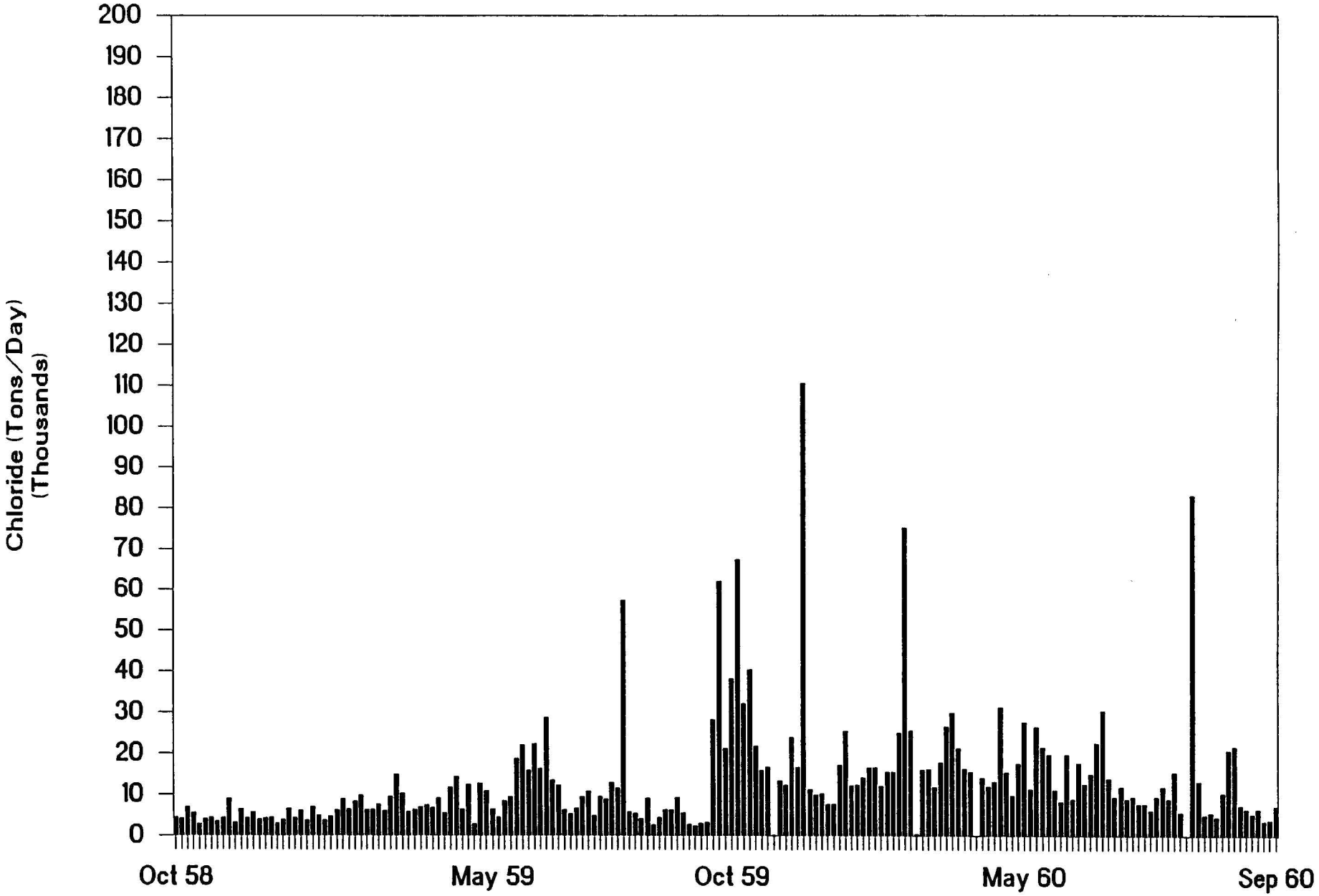

Figure 27. Graph Of Chloride (Tons per Day) Versus Time For The Van Buren Site 1958-1960.

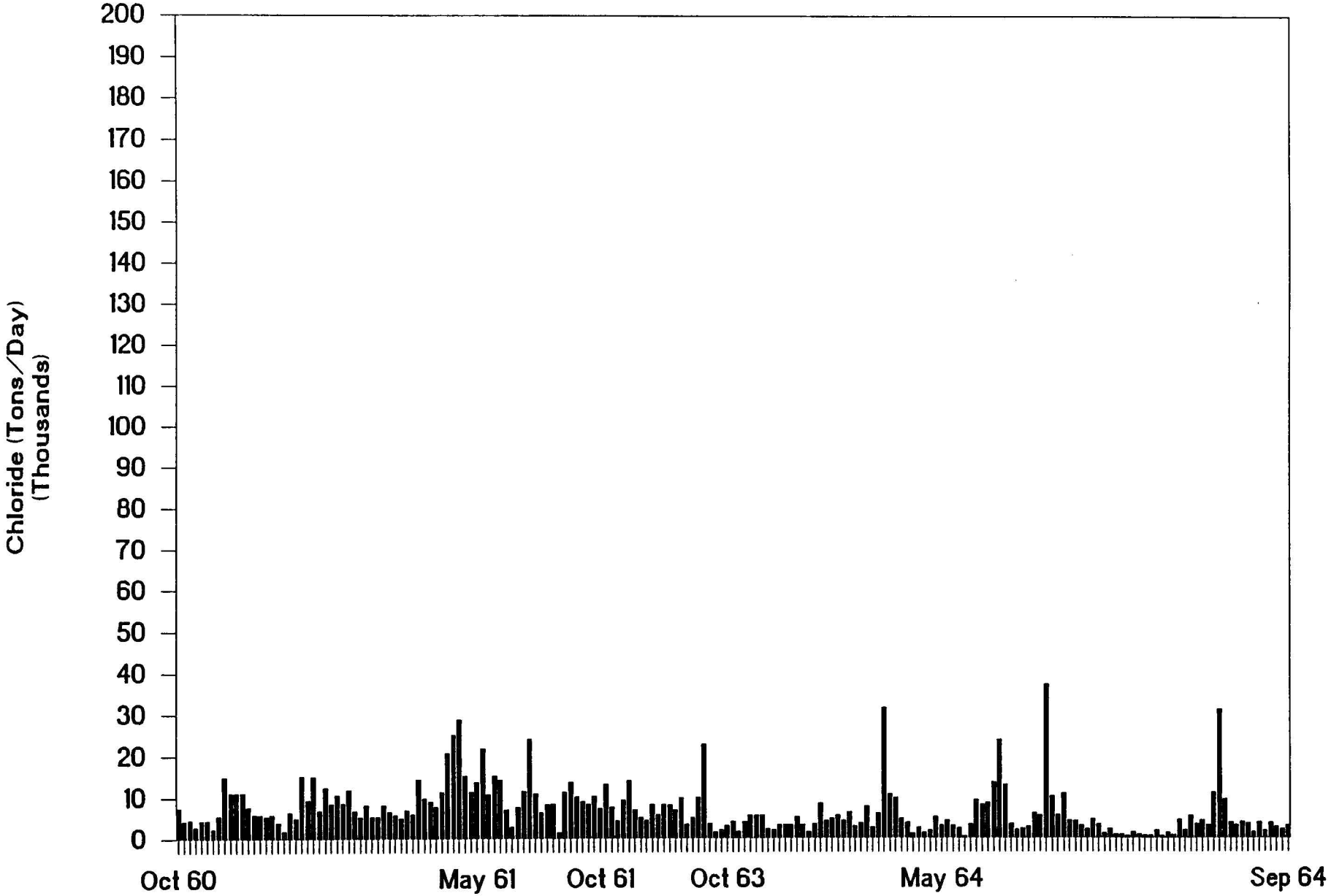

Figure 28. Graph Of Chloride (Tons per Day) Versus Time For The Van Buren Site 1960-1964.

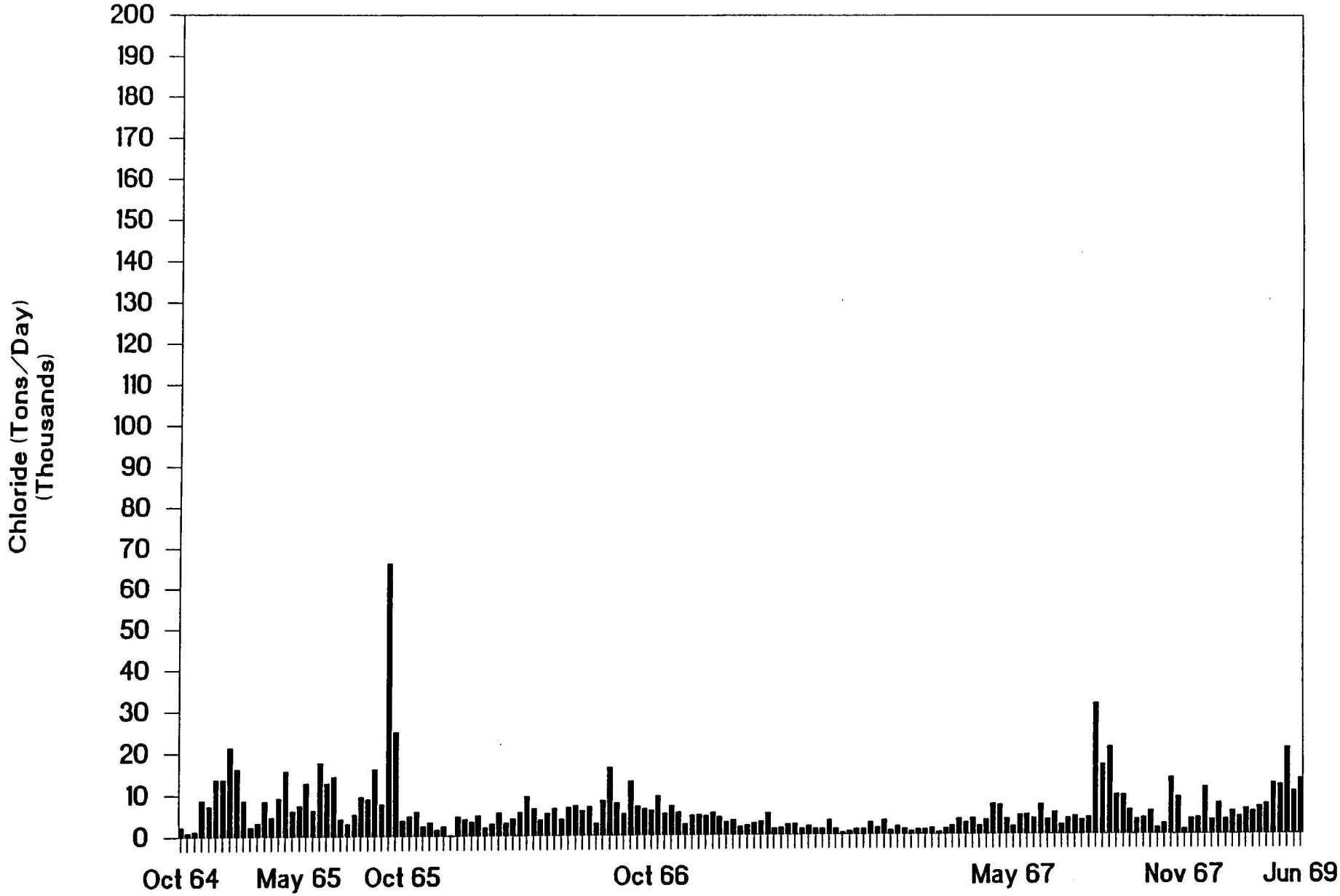

Figure 29. Graph Of Chloride (Tons per Day) Versus Time For The Van Buren Site 1964-1969.

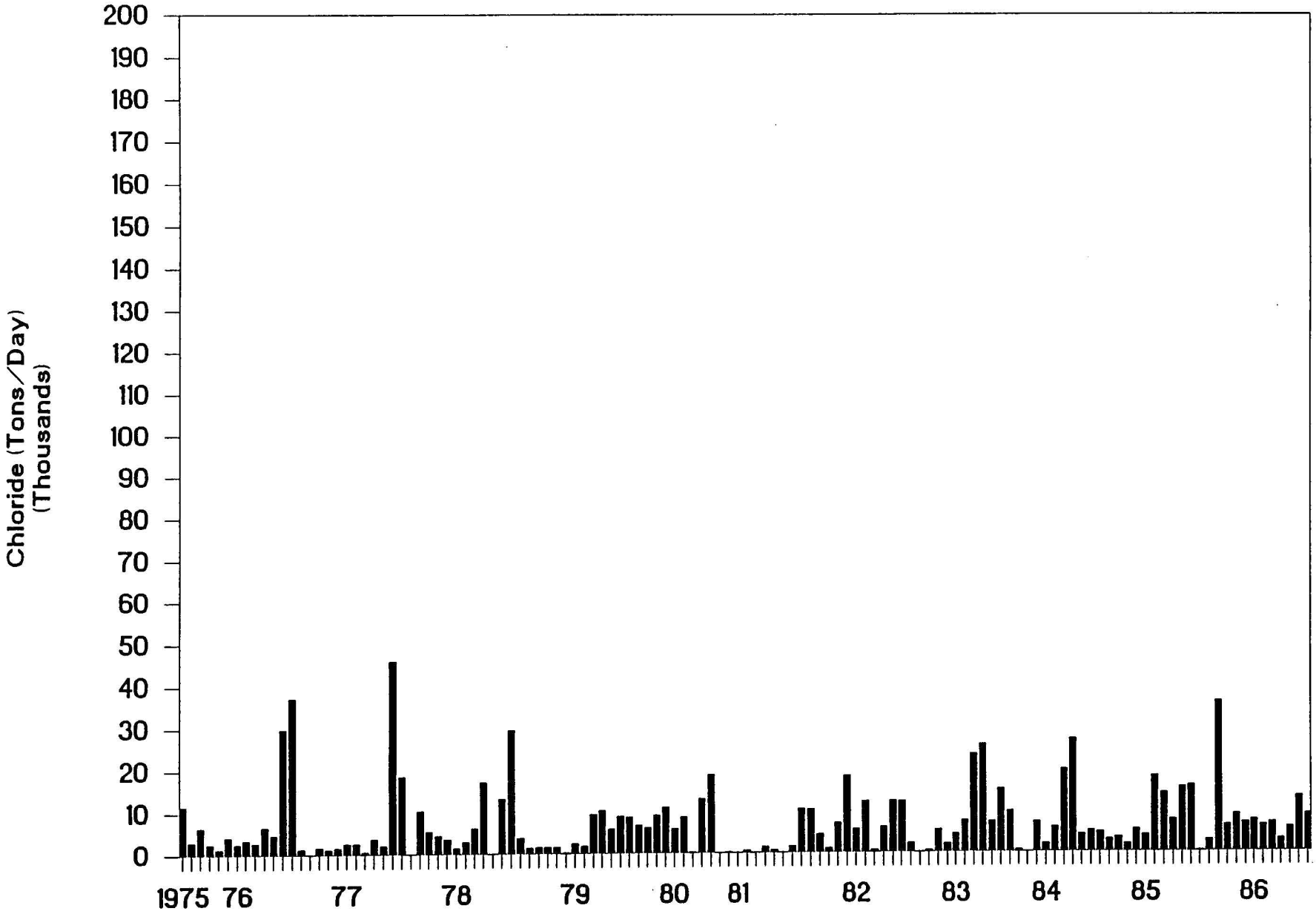

Figure 30. Graph Of Chloride (Tons per Day) Versus Time For The Van Buren Site 1974-1986.

day for the period of record from 1945 to 1969. The maximum was about 407,000 tons per day. For the period of record from 1975 until 1986, the average chloride mass was about 6,600 tons per day. The maximum was about 46,000 tons per day. An examination of the average values indicates that the mass rate during the 1975-86 period was only about one-half of that for the earlier period. Figures 31 and 32 show the chloride in tons per day plotted with flow for the periods from 1945 until 1969 and 1974 until 1986, respectively.

Coliform. Figure 33 shows the coliform data at the Van Buren sampling site from 1974 until 1986. Although the average coliform concentration exceeded 2,000 colonies per 100 milliliters, the reduction in concentration in the latter part of the 1970's and subsequent years is remarkable.

Dissolved Solids. The dissolved solids concentrations for the historical data are shown in Figures 34 through 43. The average concentration for the data from 1945 through 1969 was 779 mg/L with the range from 62 to 5,830 mg/L. The average concentration for the period from 1975 through 1986 was 347 mg/L. The range was from 124 to 646 mg/L. Although it is important to note that the number of data points for the period from 1945 to 1969 was much greater than for the period from 1975 through 1986, the large difference between the two averages is clearly important. The average for the latter period was less than one-half of that for the earlier period.

As with chloride, it is interesting to examine the mass rate of transport of the dissolved solids. Figures 44

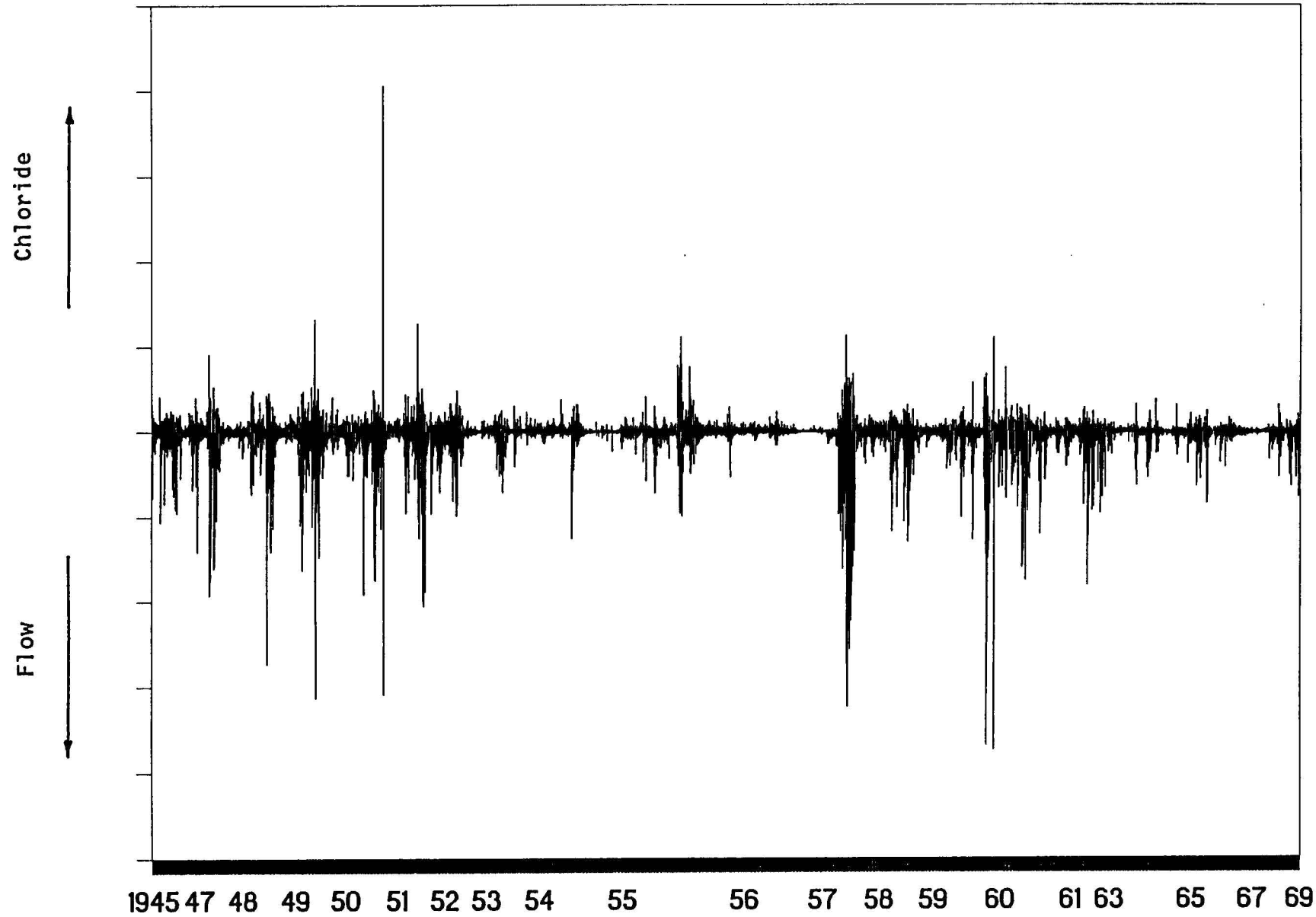

Figure 31. Graph Of Chloride (Tons per Day) And Flow Versus Time For The Van Buren Site 1945-1969.

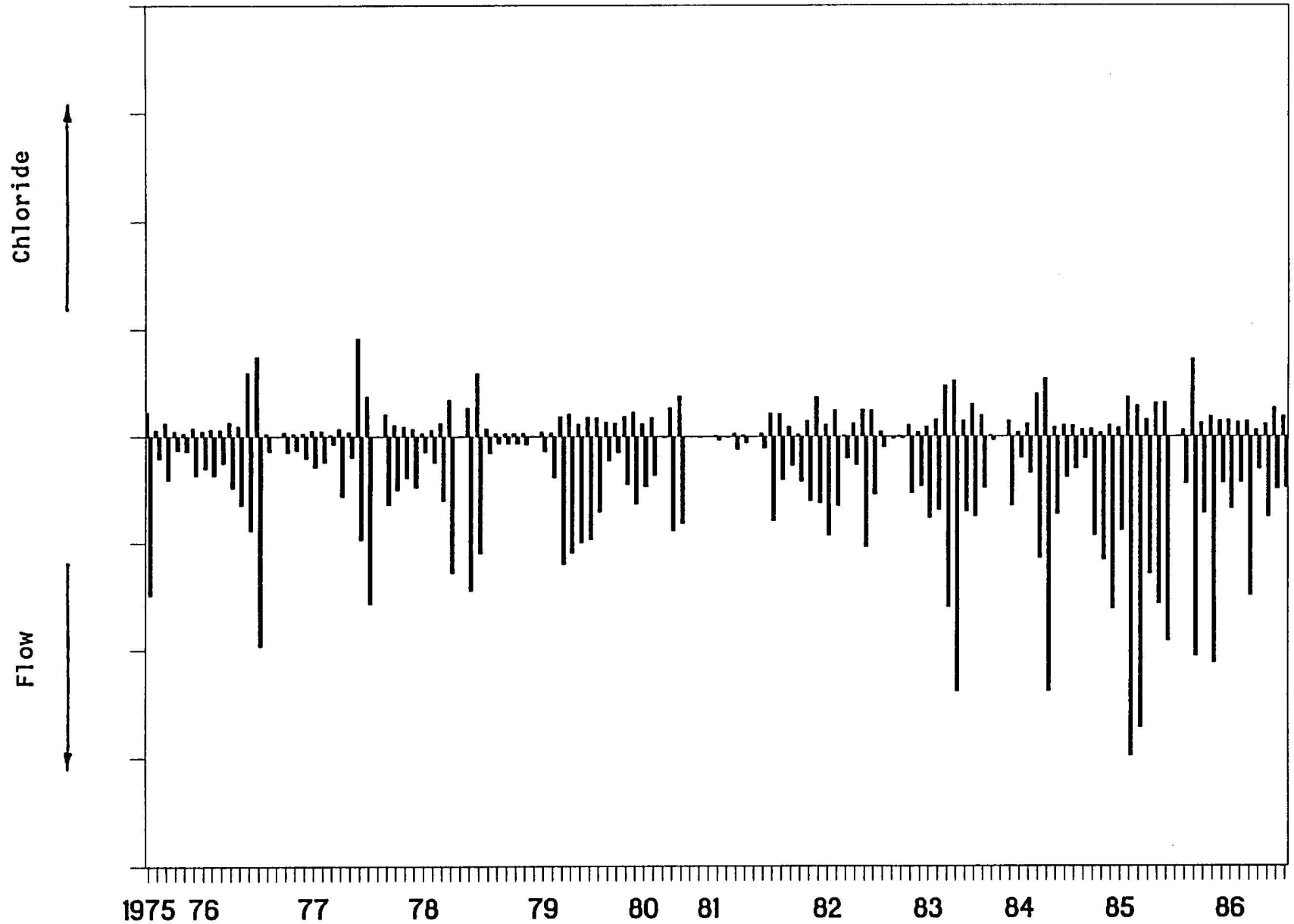

Figure 32. Graph Of Chloride (Tons per Day) And Flow Versus Time For The Van Buren Site 1974-1986.

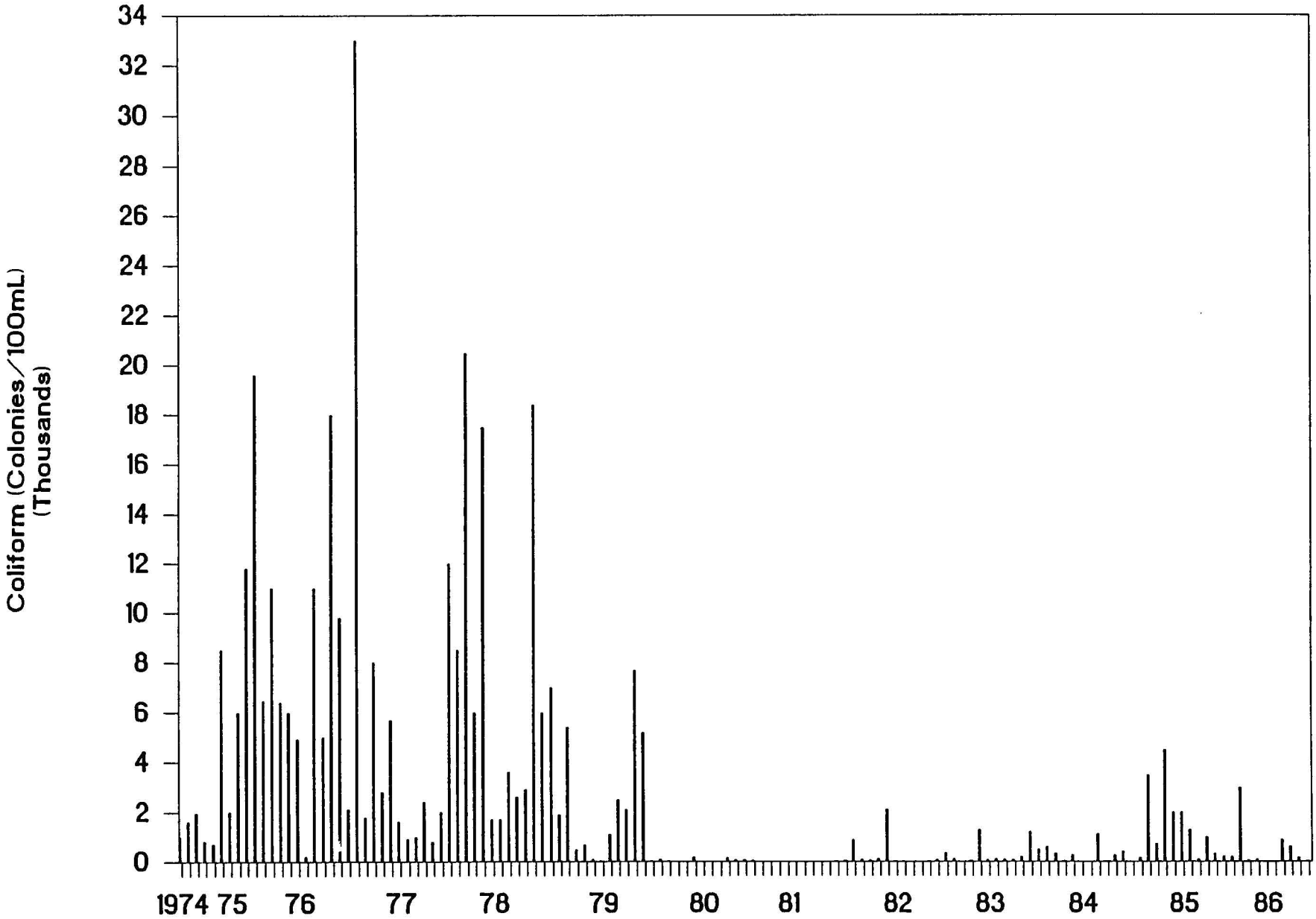

Figure 33. Graph Of Coliform Versus Time For The Van Buren Site 1974-1986.

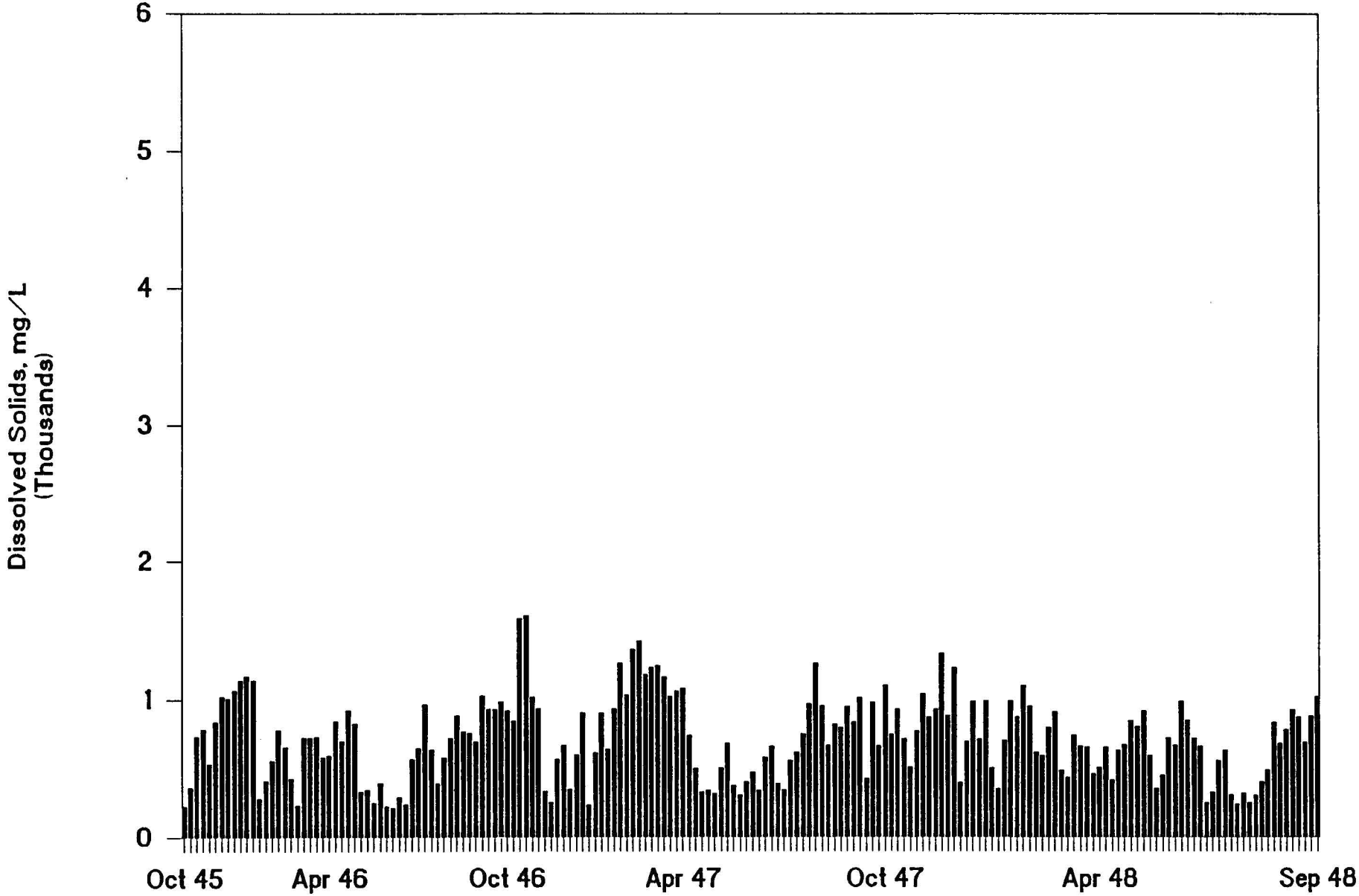

Figure 34. Graph of Dissolved Solids Versus Time For The Van Buren Site 1945-1948.

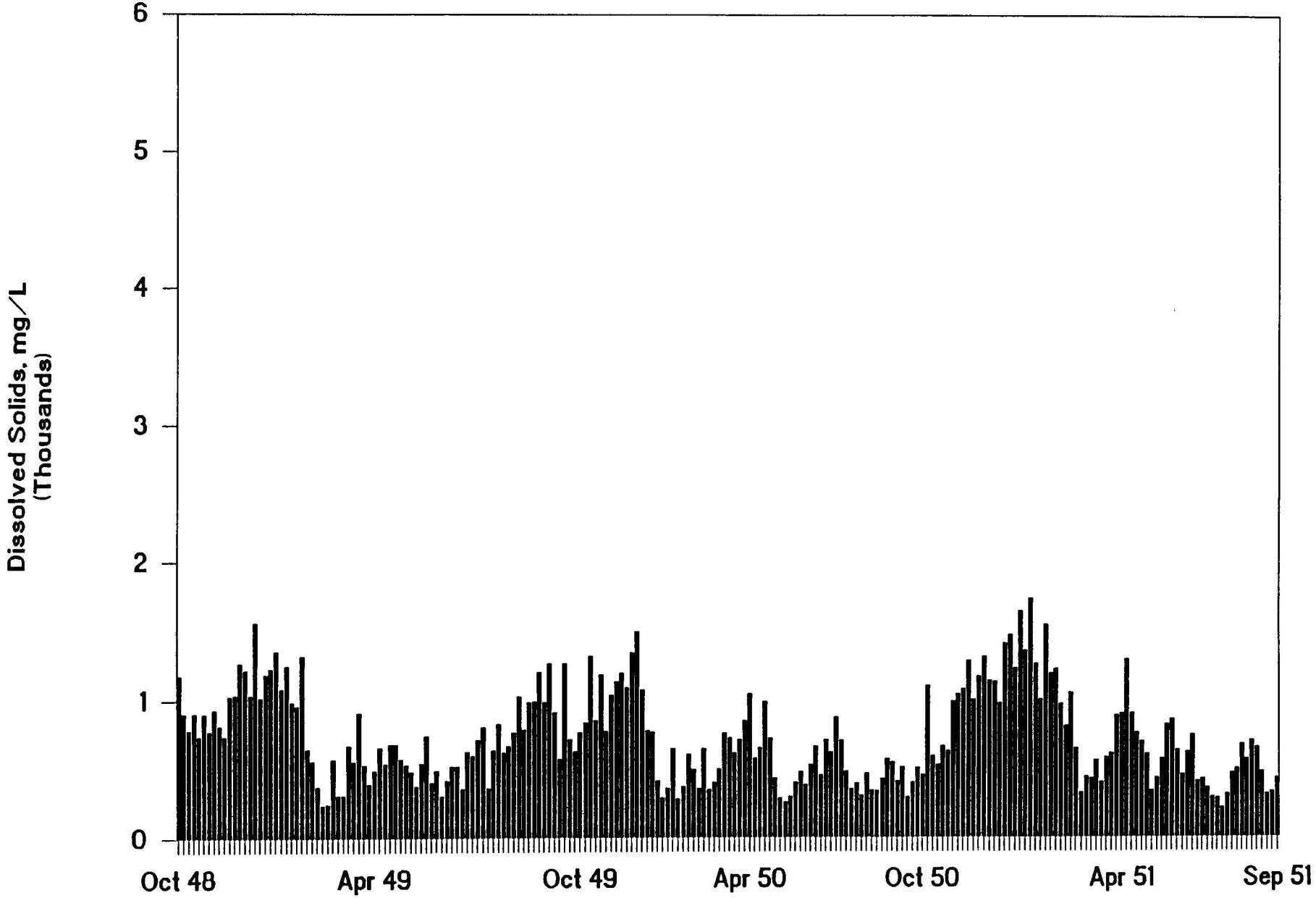

Figure 35. Graph of Dissolved Solids Versus Time For The Van Buren Site 1948-1951.

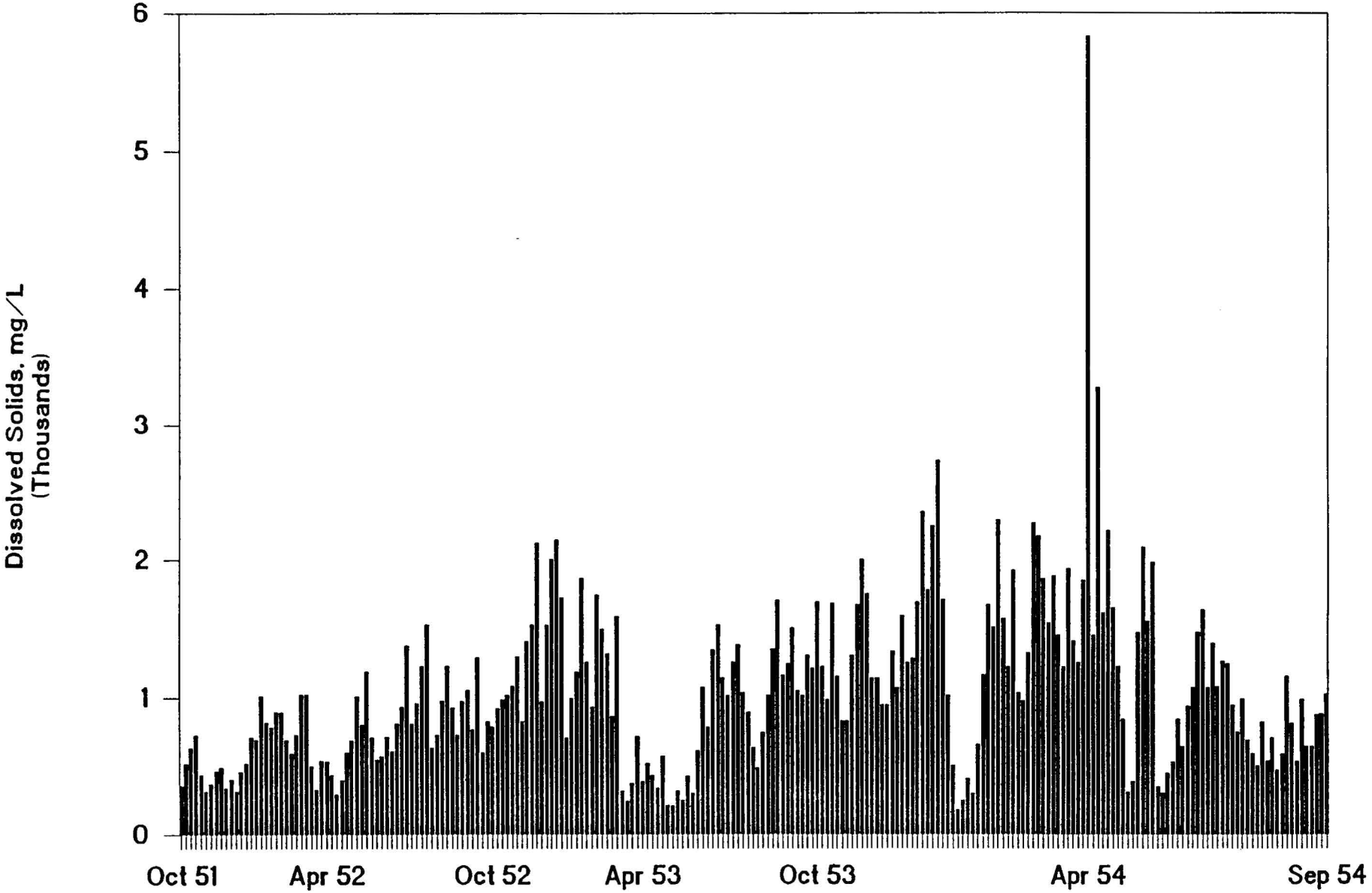

Figure 36. Graph of Dissolved Solids Versus Time For The Van Buren Site 1951-1954.

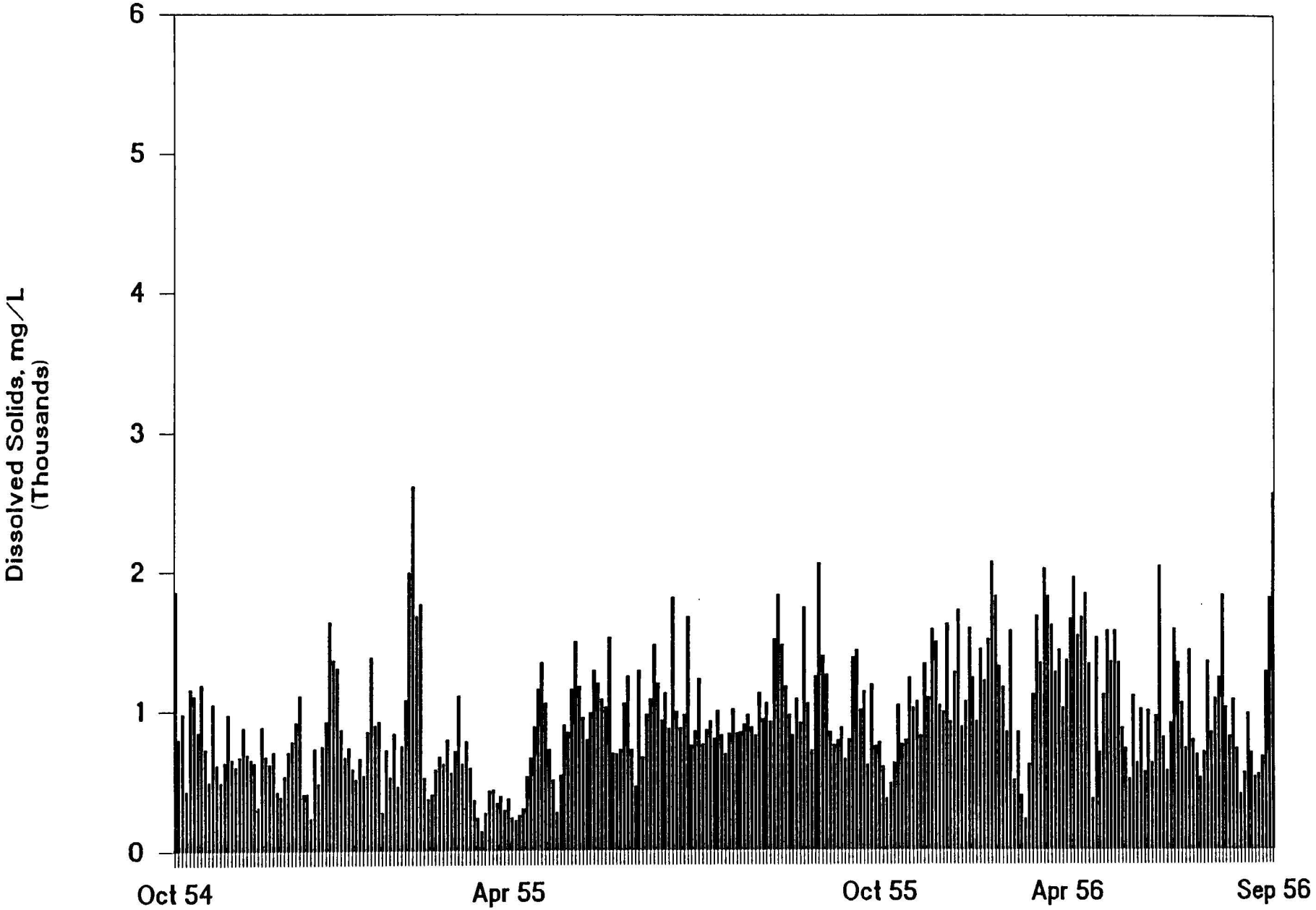

Figure 37. Graph of Dissolved Solids Versus Time For The Van Buren Site 1954-1956.

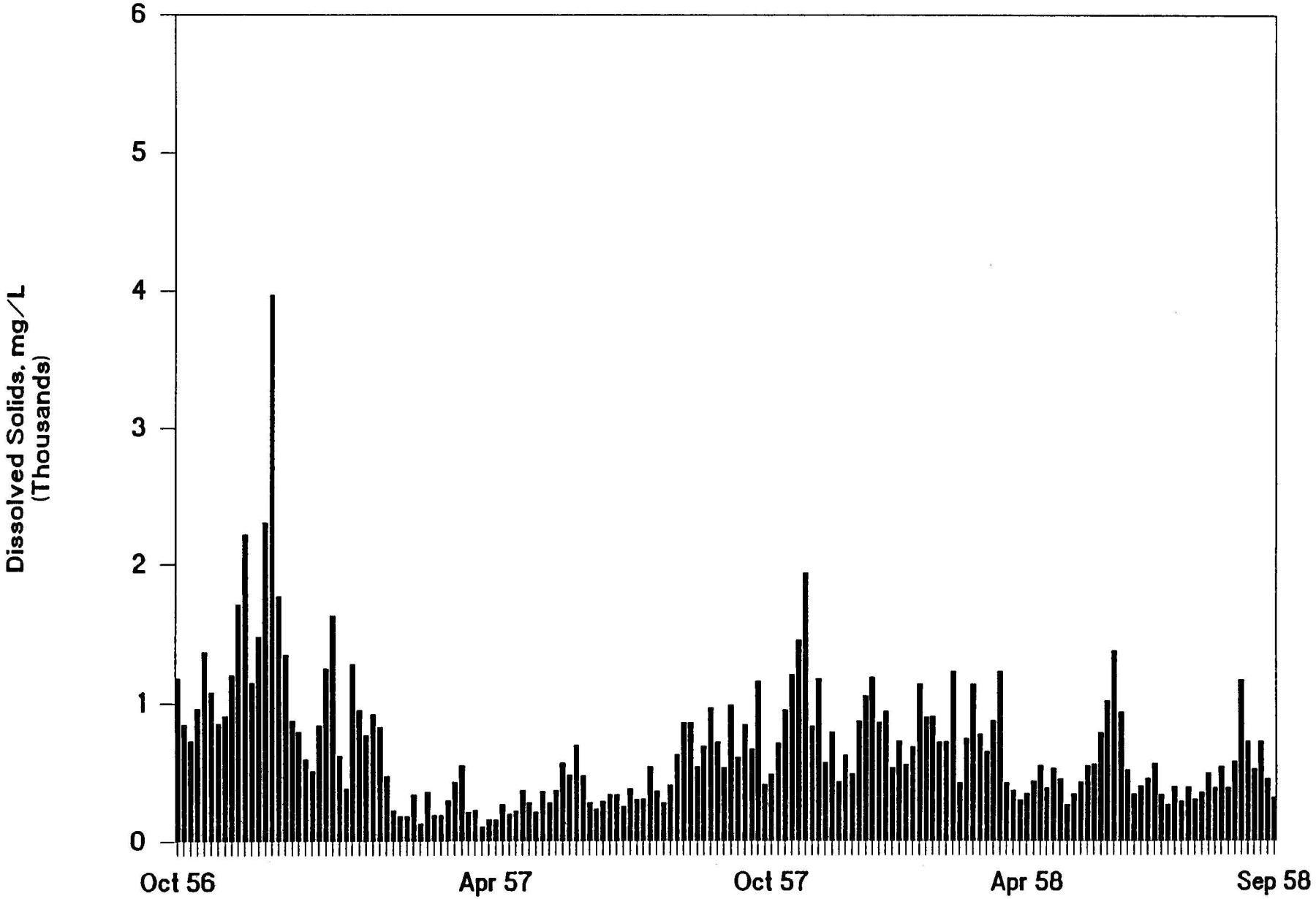

Figure 38. Graph of Dissolved Solids Versus Time For The Van Buren Site 1956-1958.

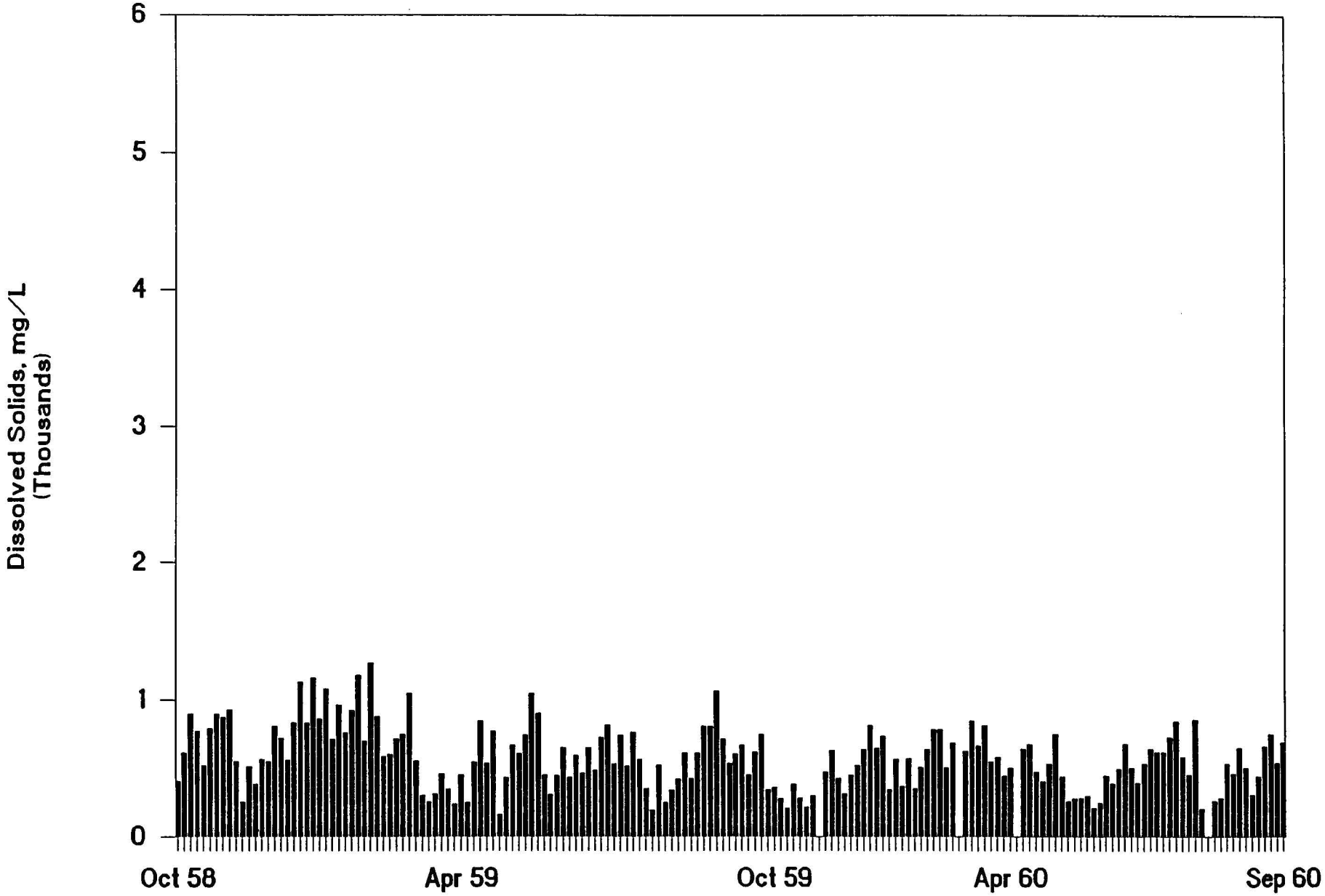

Figure 39. Graph of Dissolved Solids Versus Time For The Van Buren Site 1958-1960.

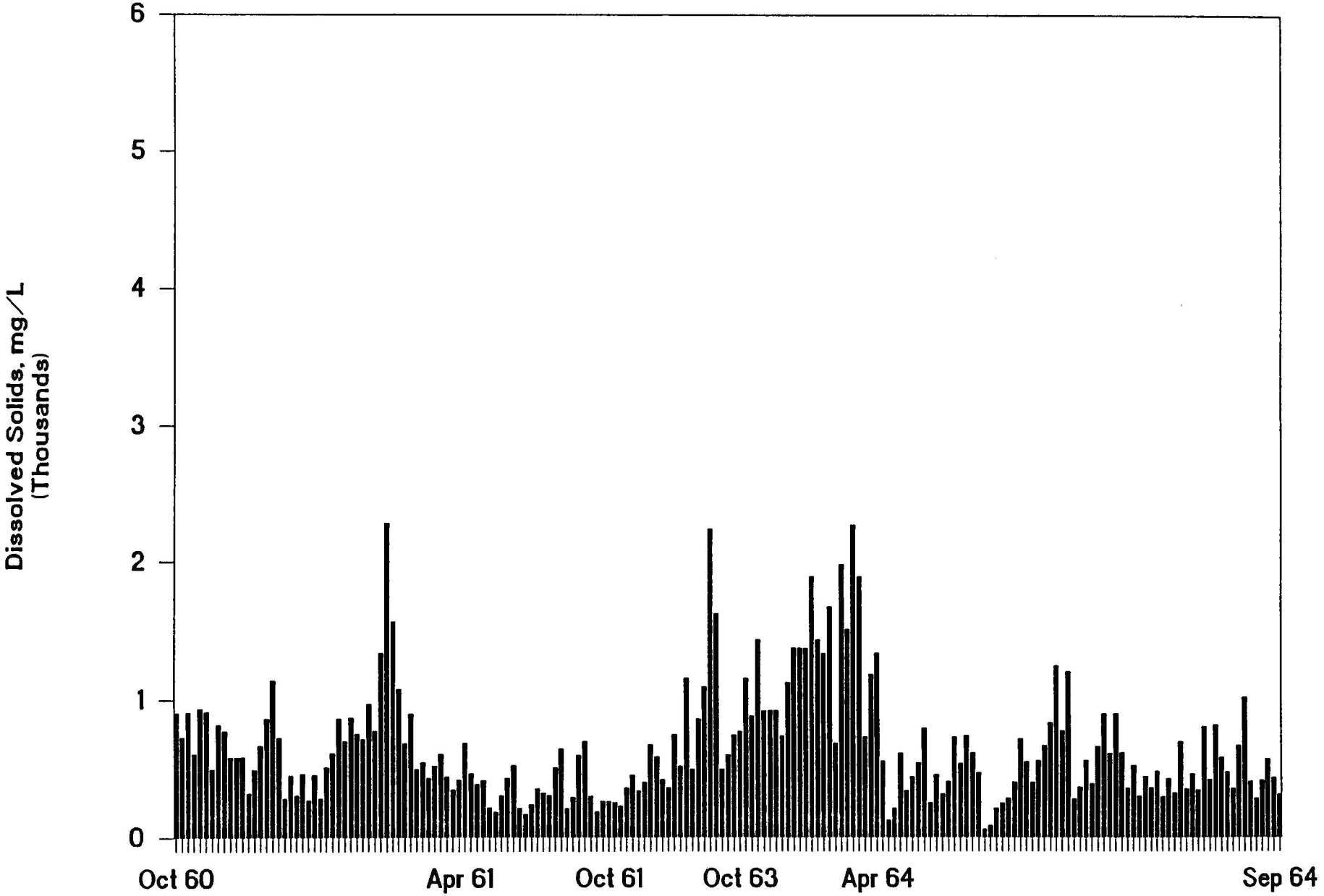

Figure 40. Graph of Dissolved Solids Versus Time For The Van Buren Site 1960-1964.

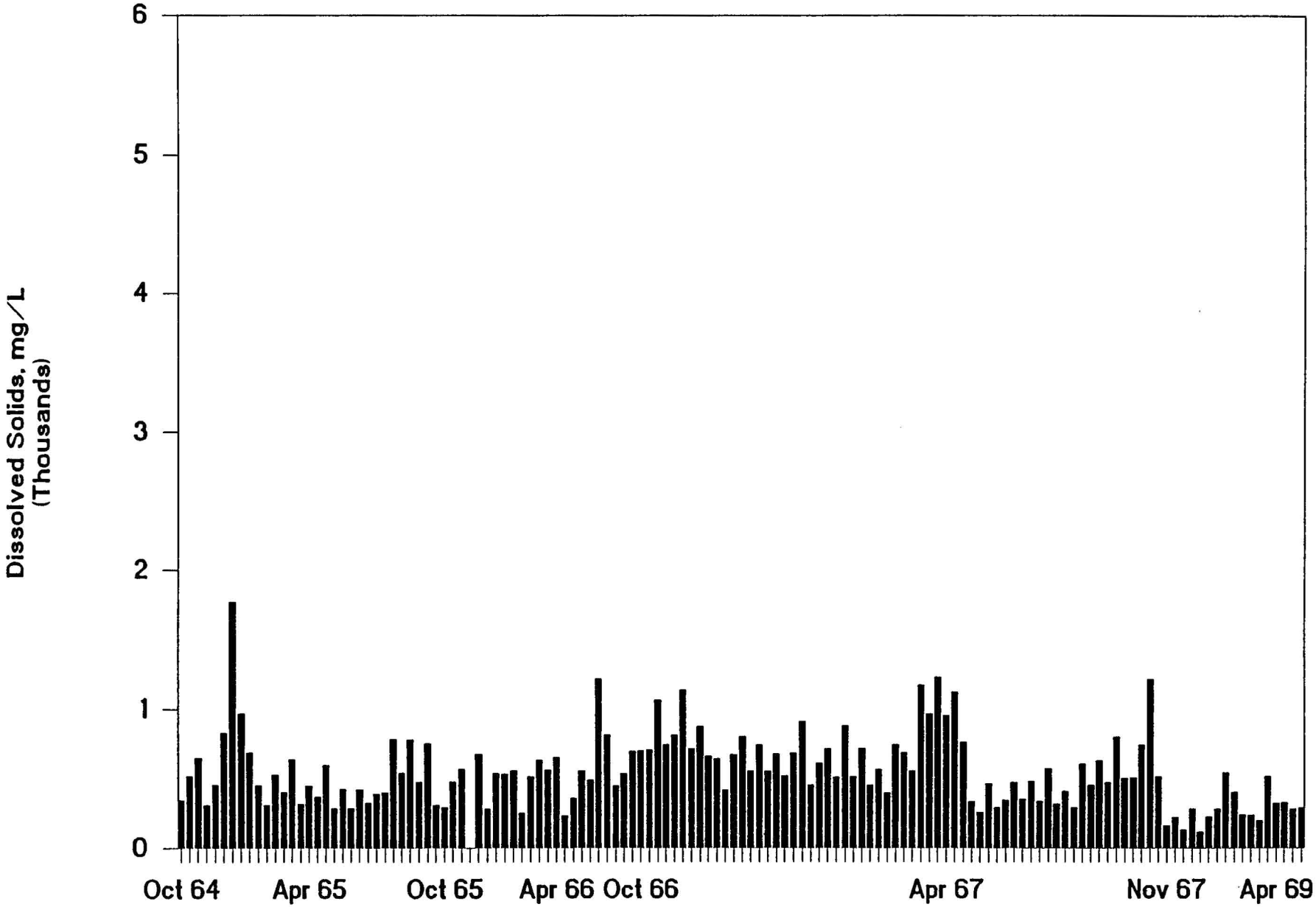

Figure 41. Graph of Dissolved Solids Versus Time For The Van Buren Site 1964-1969.

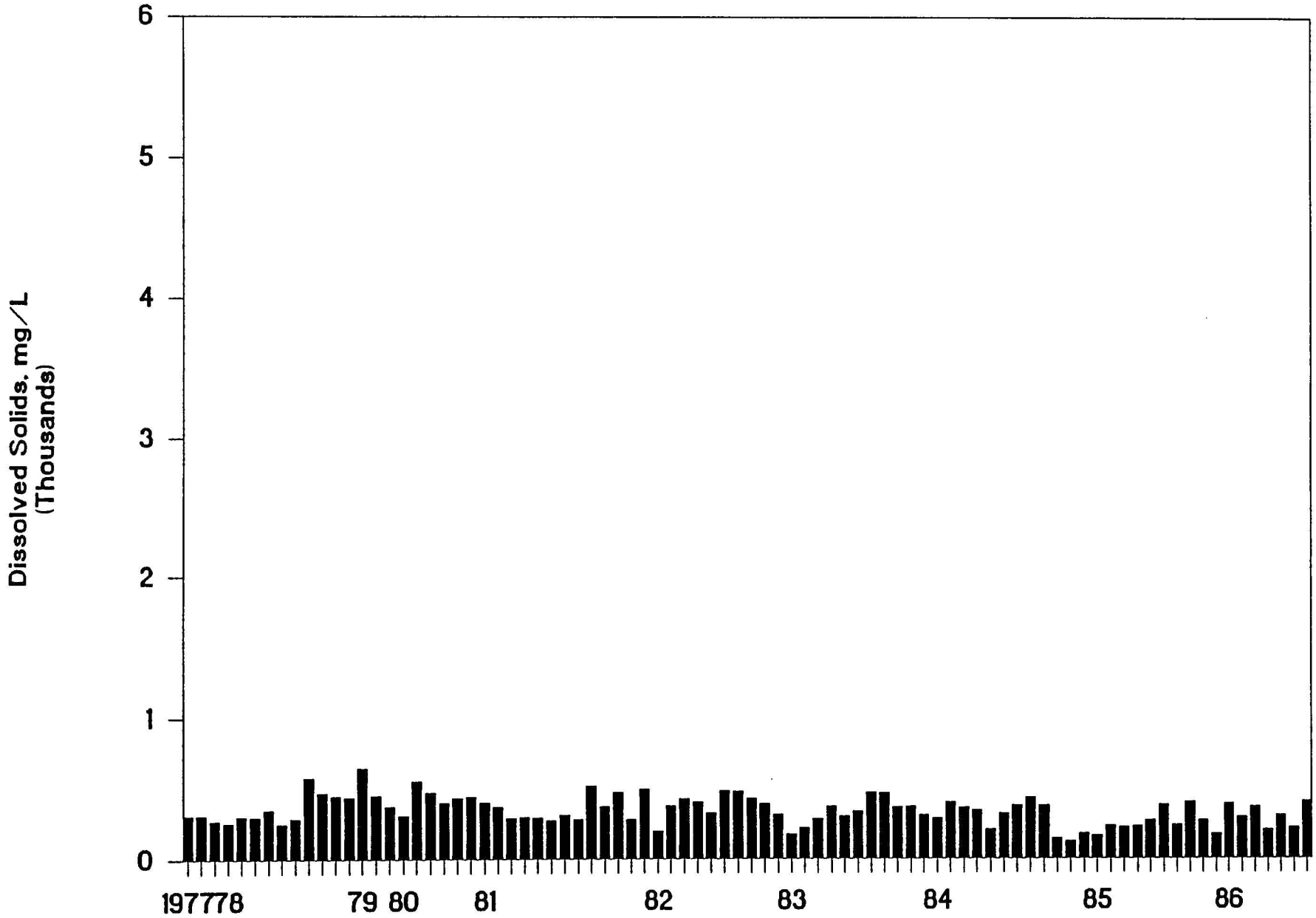

Figure 42. Graph of Dissolved Solids Versus Time For The Van Buren Site 1977-1986.

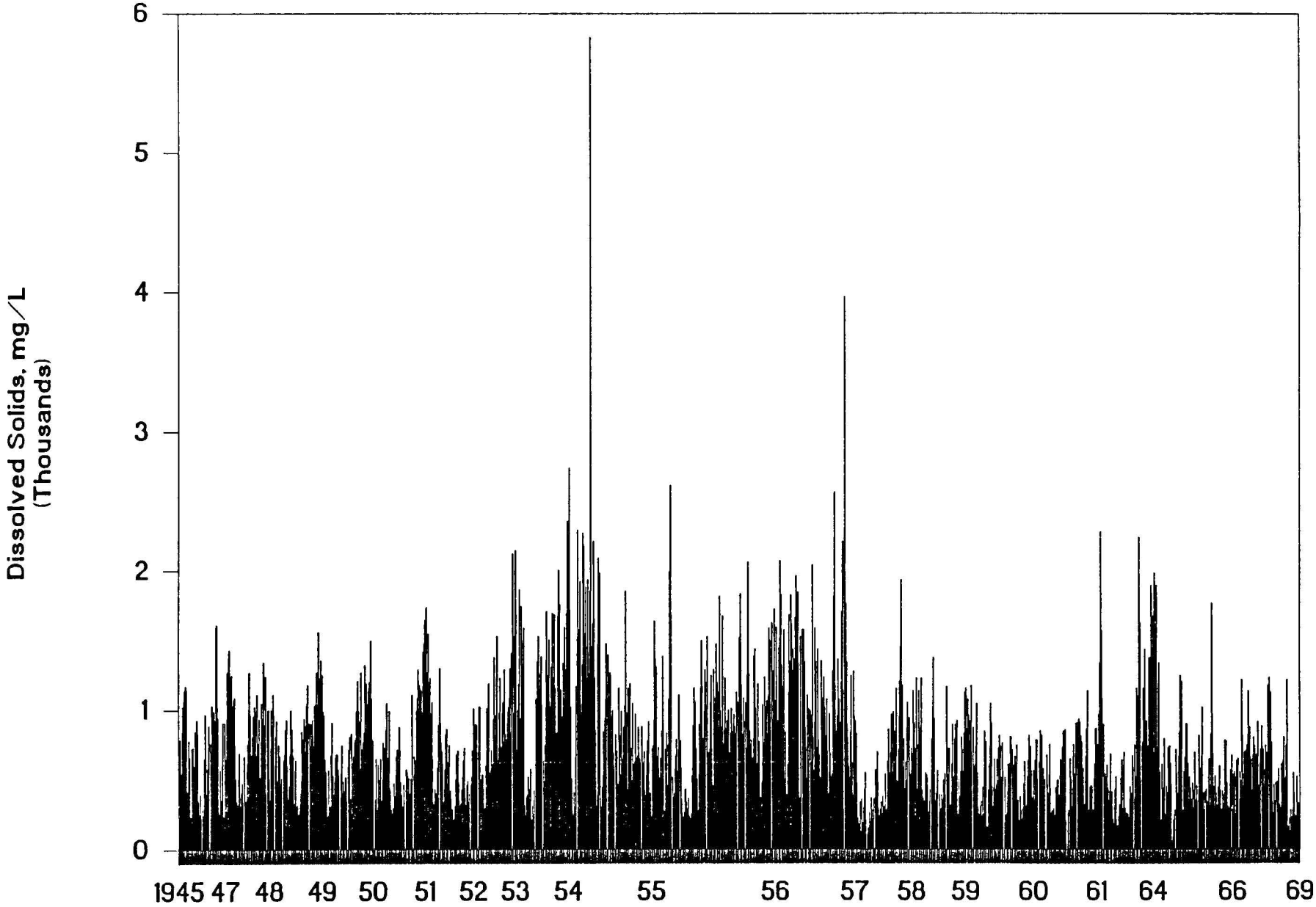

Figure 43. Graph of Dissolved Solids Versus Time For The Van Buren Site 1945-1969.

through 51 show the data, in tons per day, on a relatively short time frame basis. The average dissolved solids mass flow rate for the period from 1945 through 1969 was about 35,250 tons per day compared with an average of 27,327 tons per day for the period from 1975 through 1986. The maximum mass rates of transport were 922,150 and 113,555 tons per day, respectively, for the earlier and later periods.

Figures 52 and 53 show both dissolved solids and flow plotted as a function of time for the periods of time from 1945 until 1969 and from 1975 until 1986, respectively. As shown by Figure 52, there clearly was a tendency for increased dissolved solids concentrations at lower flow rates during the period of time from 1945 until 1969. This tendency was not discernible for the data from 1969 until 1986.

Potassium. Only a limited amount of potassium data were available for the Van Buren site. These data are shown in Figure 54. There were no unusual tendencies apparent from analysis of the data.

Sodium. The sodium data for the Van Buren site are shown in Figures 55 through 62. Figure 63 shows all data from 1945 through 1969 for this site. The sodium concentrations are also plotted with flow versus time on short-term cycles in Figures 64 through 71. The average sodium concentration at the Van Buren site was 183 mg/L from 1945 until 1969. Sodium concentrations ranged from 13 to 1,510 mg/L during this period.

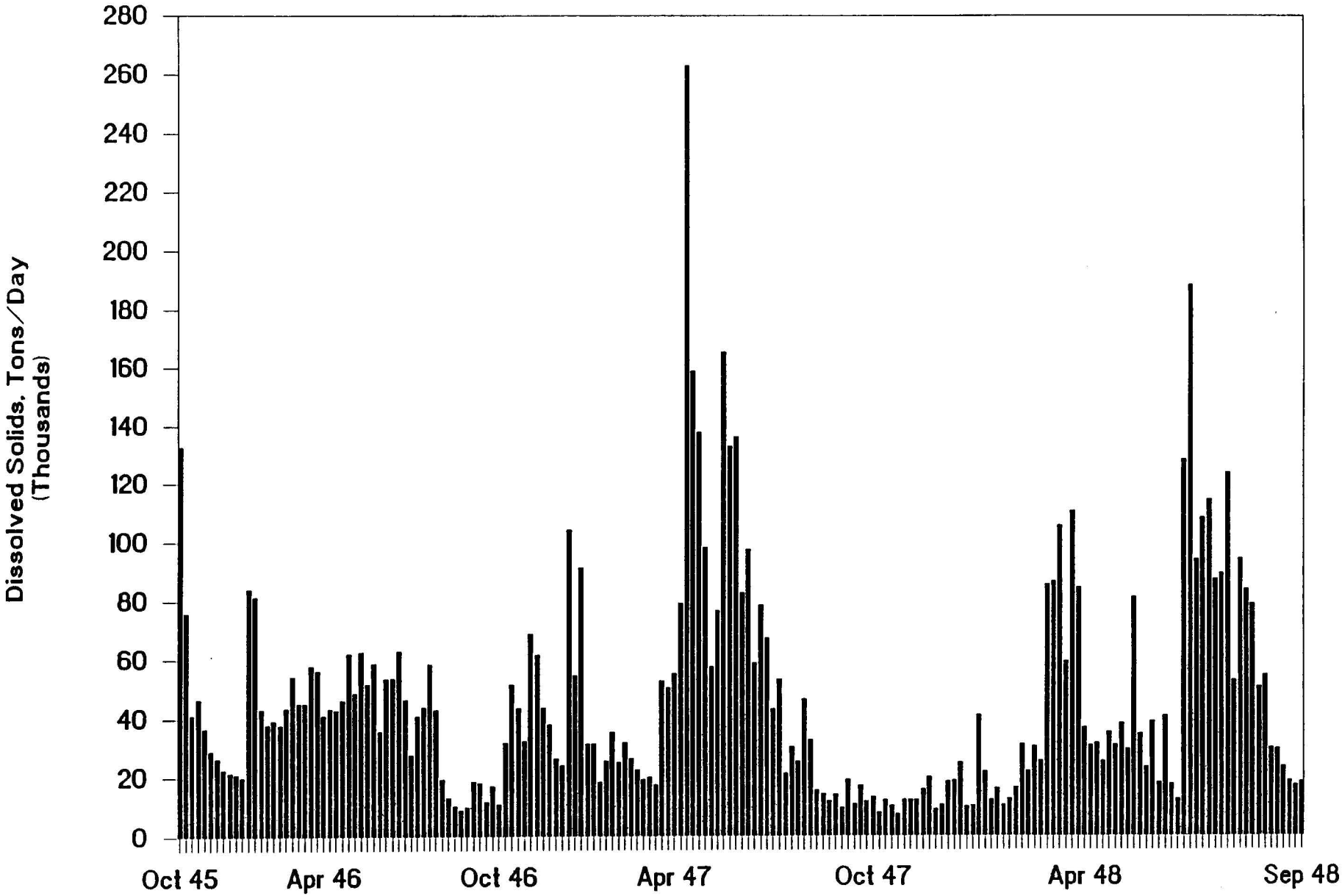

Figure 44. Graph of Dissolved Solids (Tons per Day) Versus Time For The Van Buren Site 1945-1948.

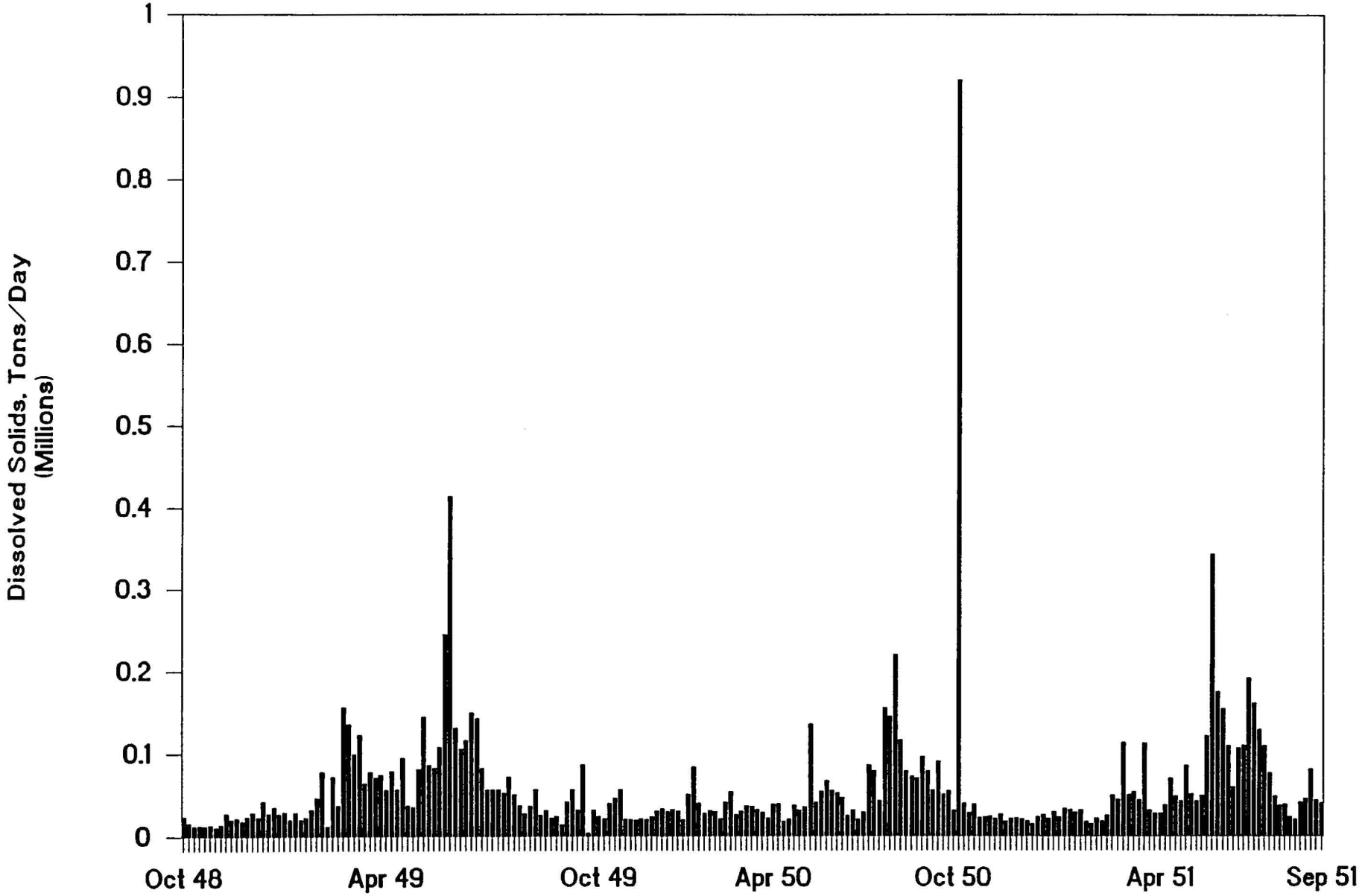

Figure 45. Graph of Dissolved Solids (Tons per Day) Versus Time For The Van Buren Site 1948-1951.

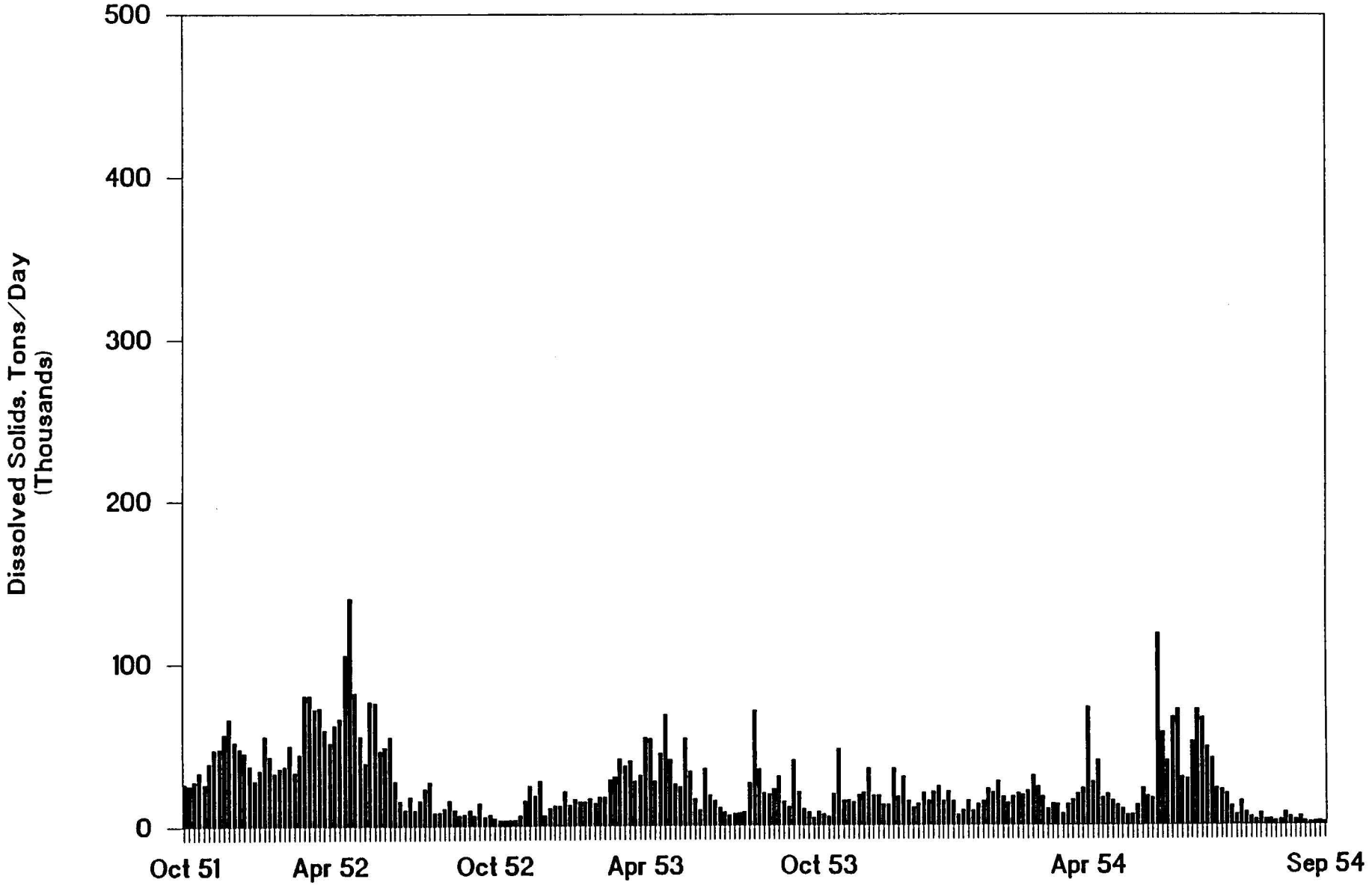

Figure 46. Graph of Dissolved Solids (Tons per Day) Versus Time For The Van Buren Site 1951-1954.

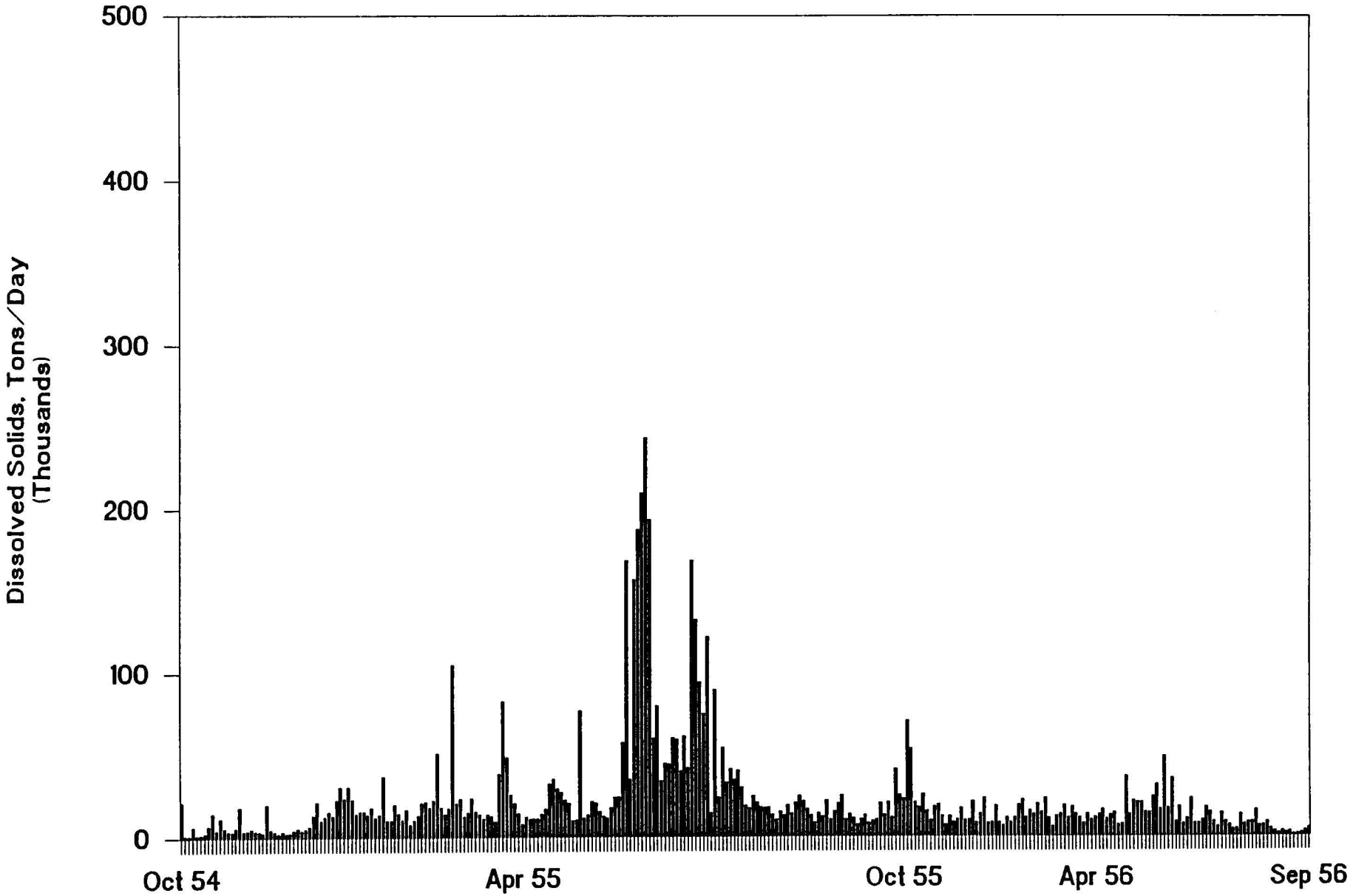

Figure 47. Graph of Dissolved Solids (Tons per Day) Versus Time For The Van Buren Site 1954-1956.

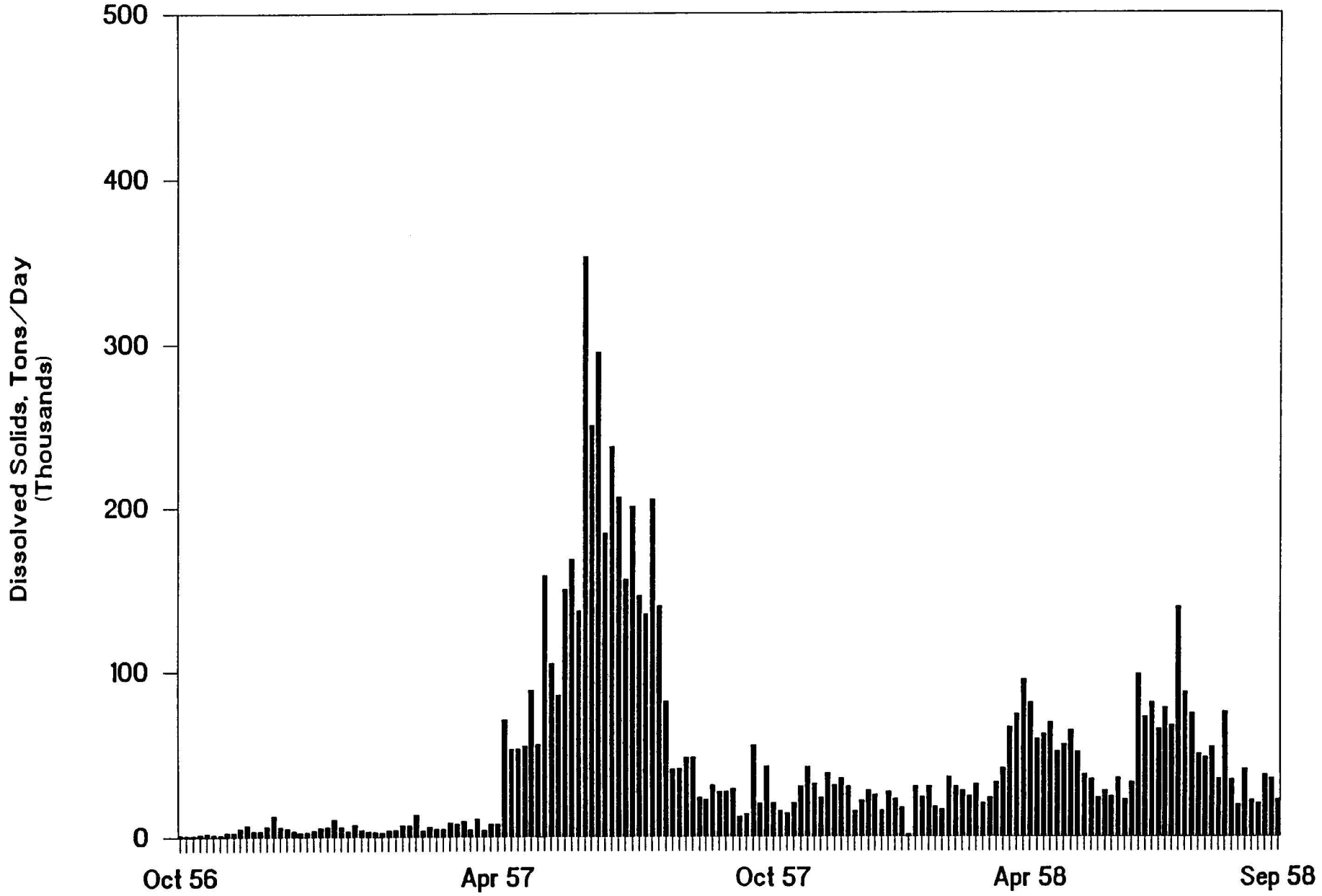

Figure 48. Graph of Dissolved Solids (Tons per Day) Versus Time For The Van Buren Site 1956-1958.

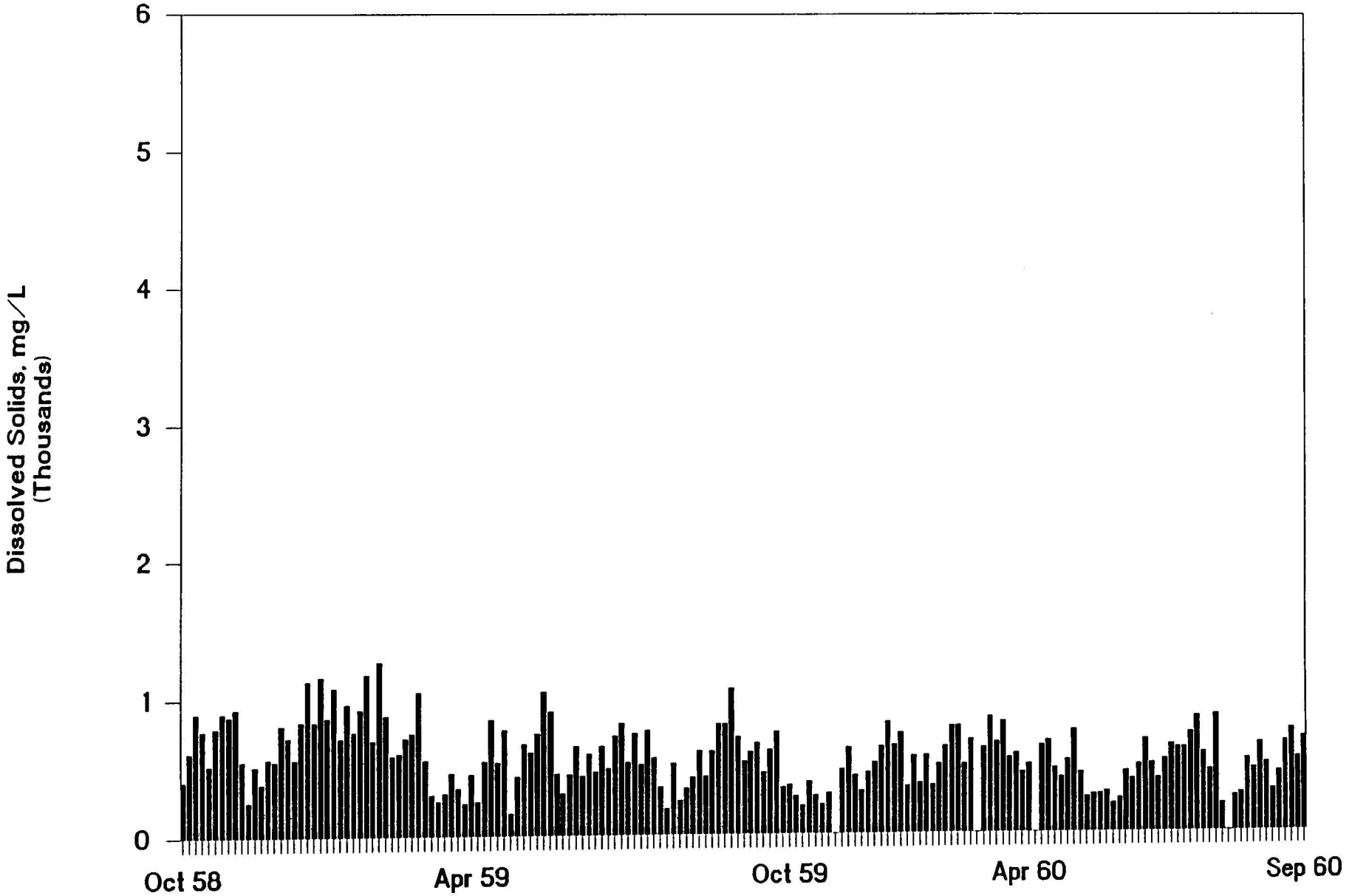

Figure 49. Graph of Dissolved Solids (Tons per Day) Versus Time For The Van Buren Site 1958-1960.

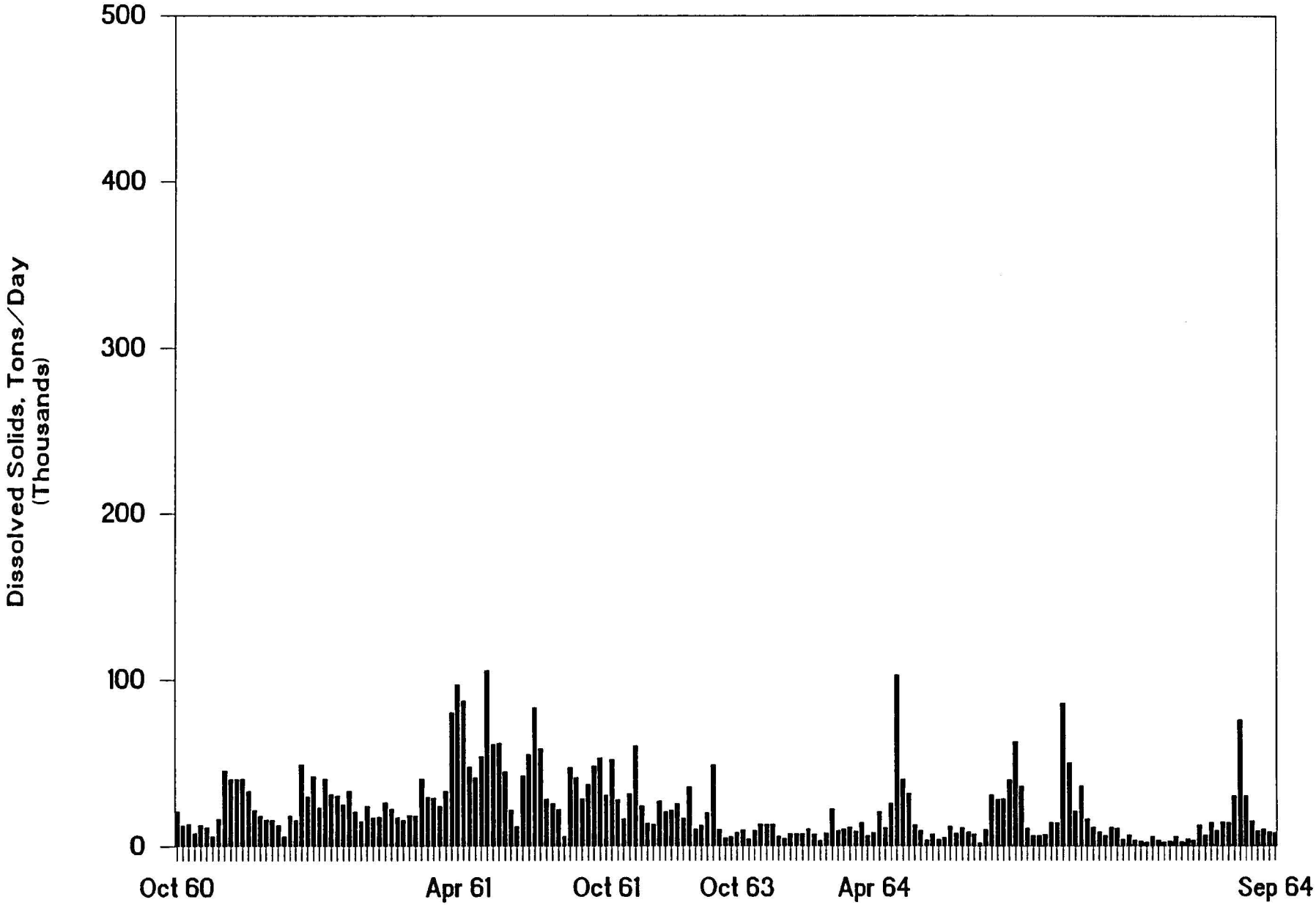

Figure 50. Graph of Dissolved Solids (Tons per Day) Versus Time For The Van Buren Site 1960-1964.

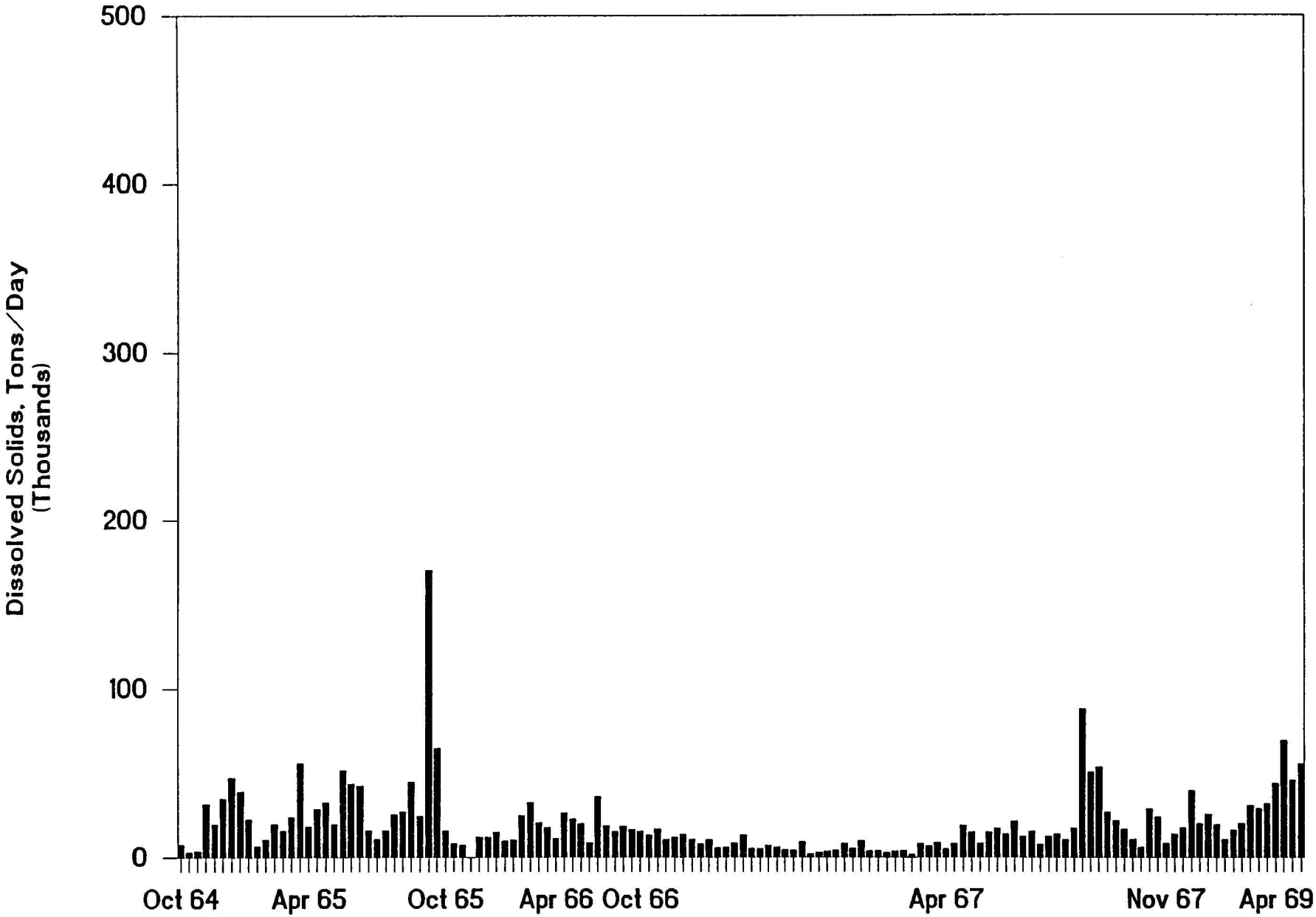

Figure 51. Graph of Dissolved Solids (Tons per Day) Versus Time For The Van Buren Site 1964-1969.

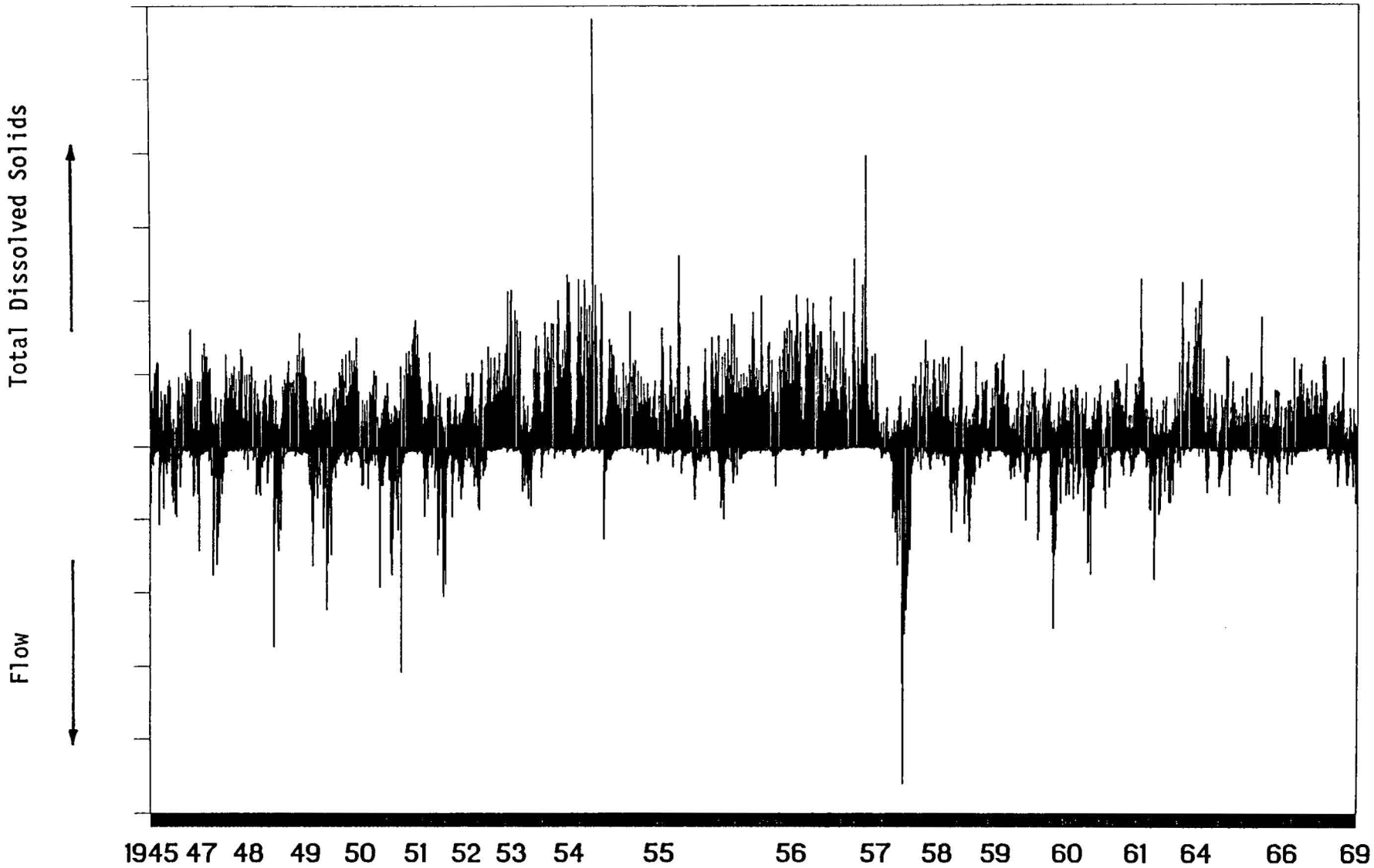

Figure 52. Graph of Dissolved Solids and Flow Versus Time For The Van Buren Site 1945-1969.

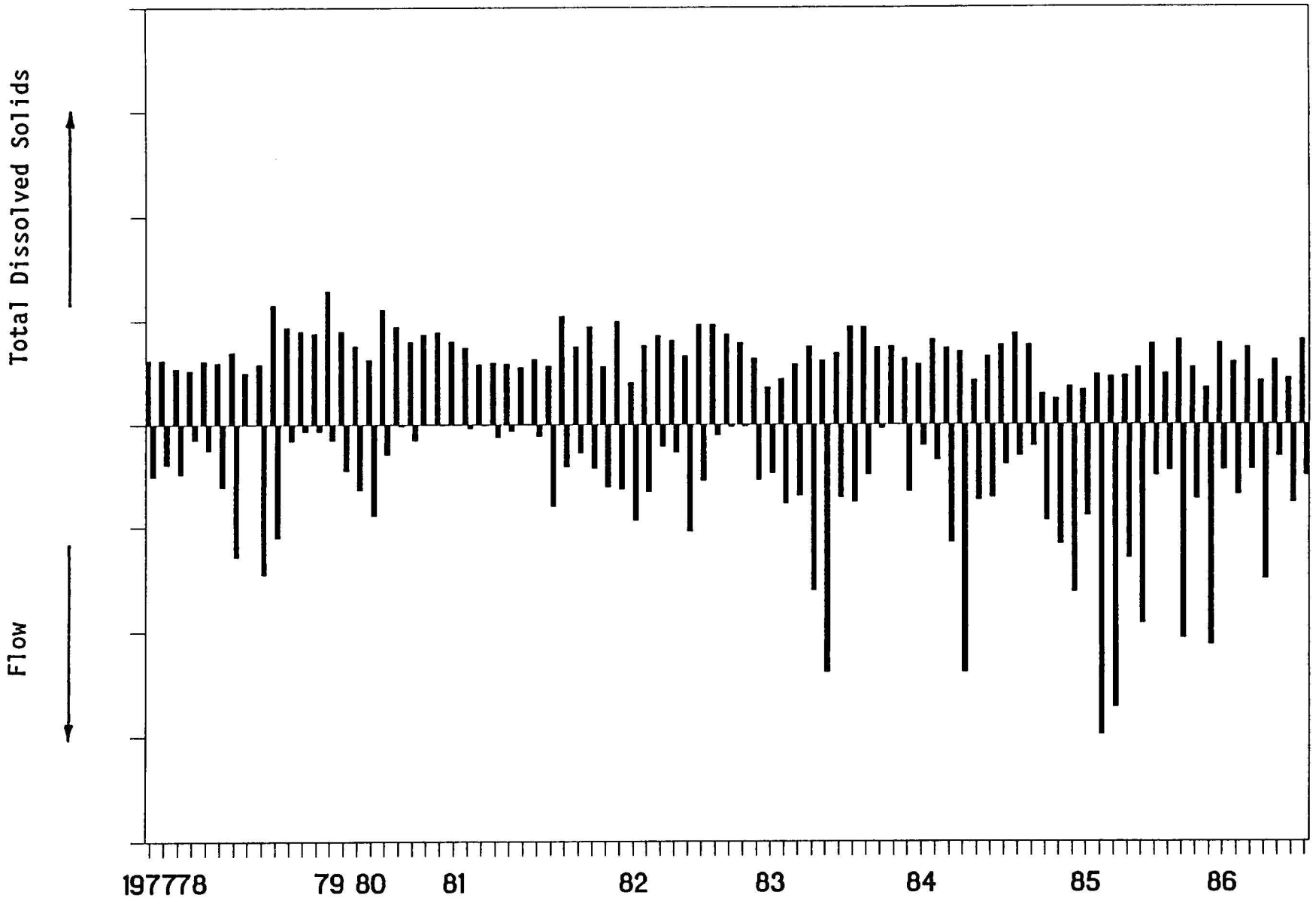

Figure 53. Graph of Dissolved Solids and Flow Versus Time For The Van Buren Site 1977-1986.

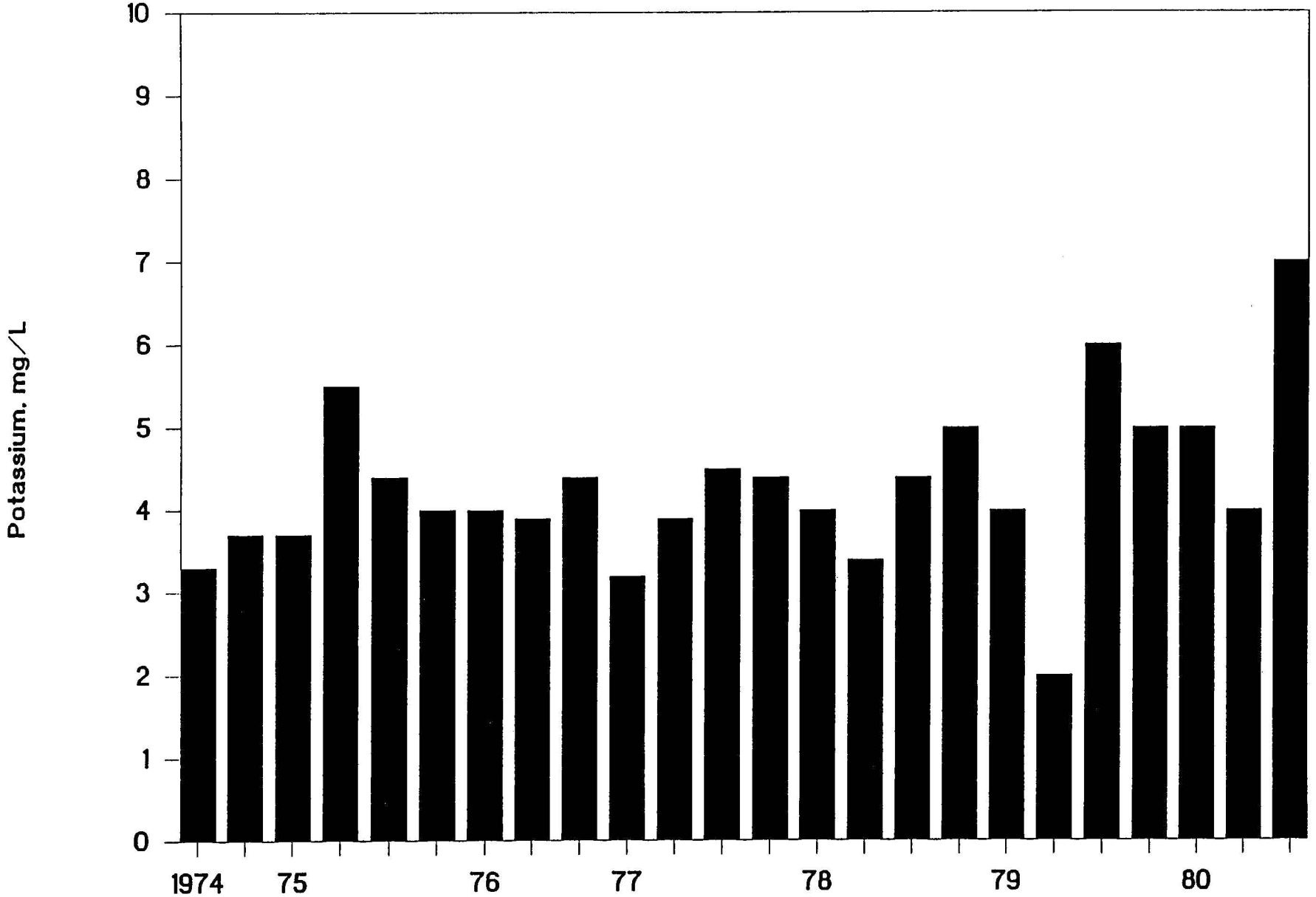

Figure 54. Graph of Potassium Versus Time For The Van Buren Site 1974-1981.

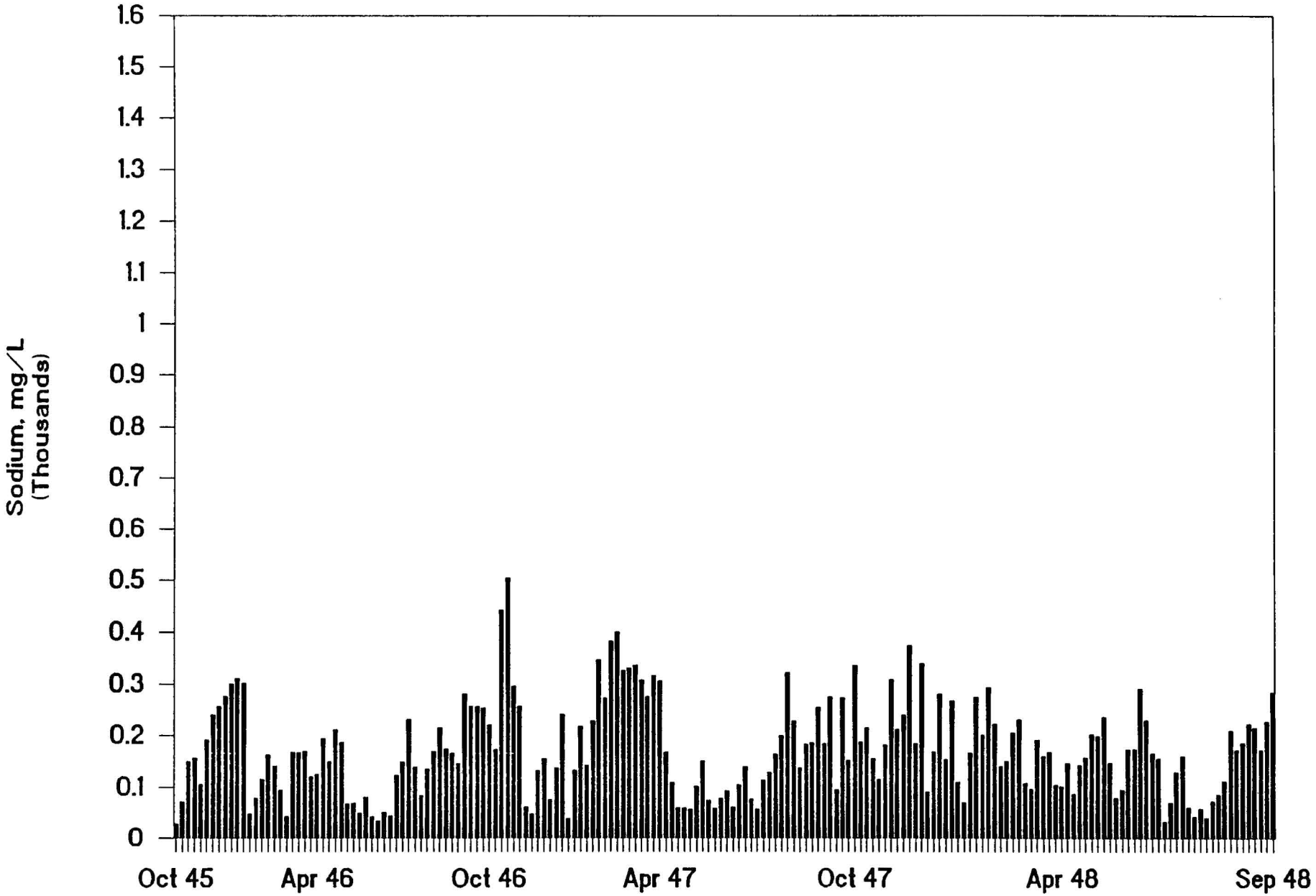

Figure 55. Graph of Sodium Versus Time For The Van Buren Site 1945-1948.

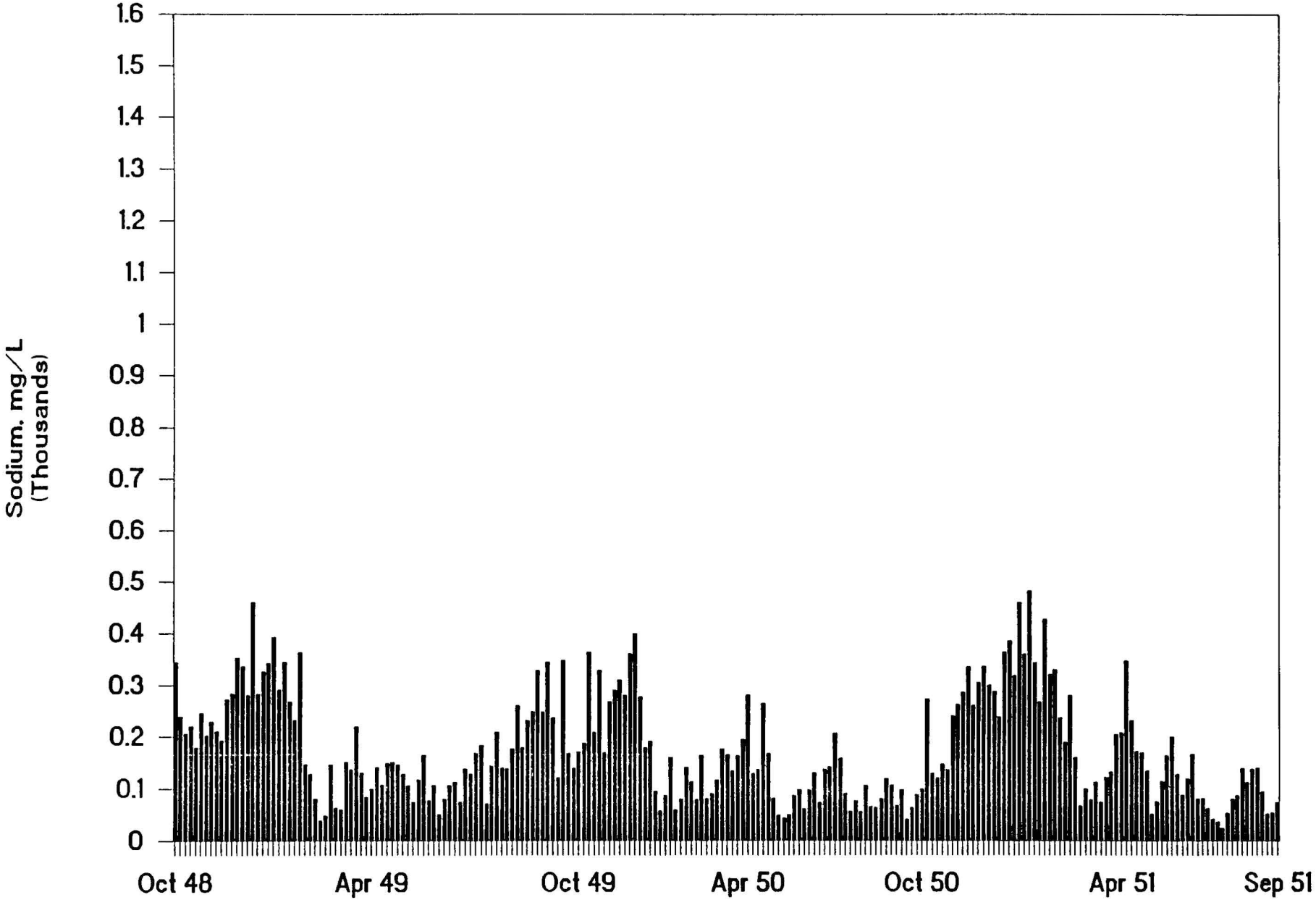

Figure 56. Graph of Sodium Versus Time For The Van Buren Site 1948-1951.

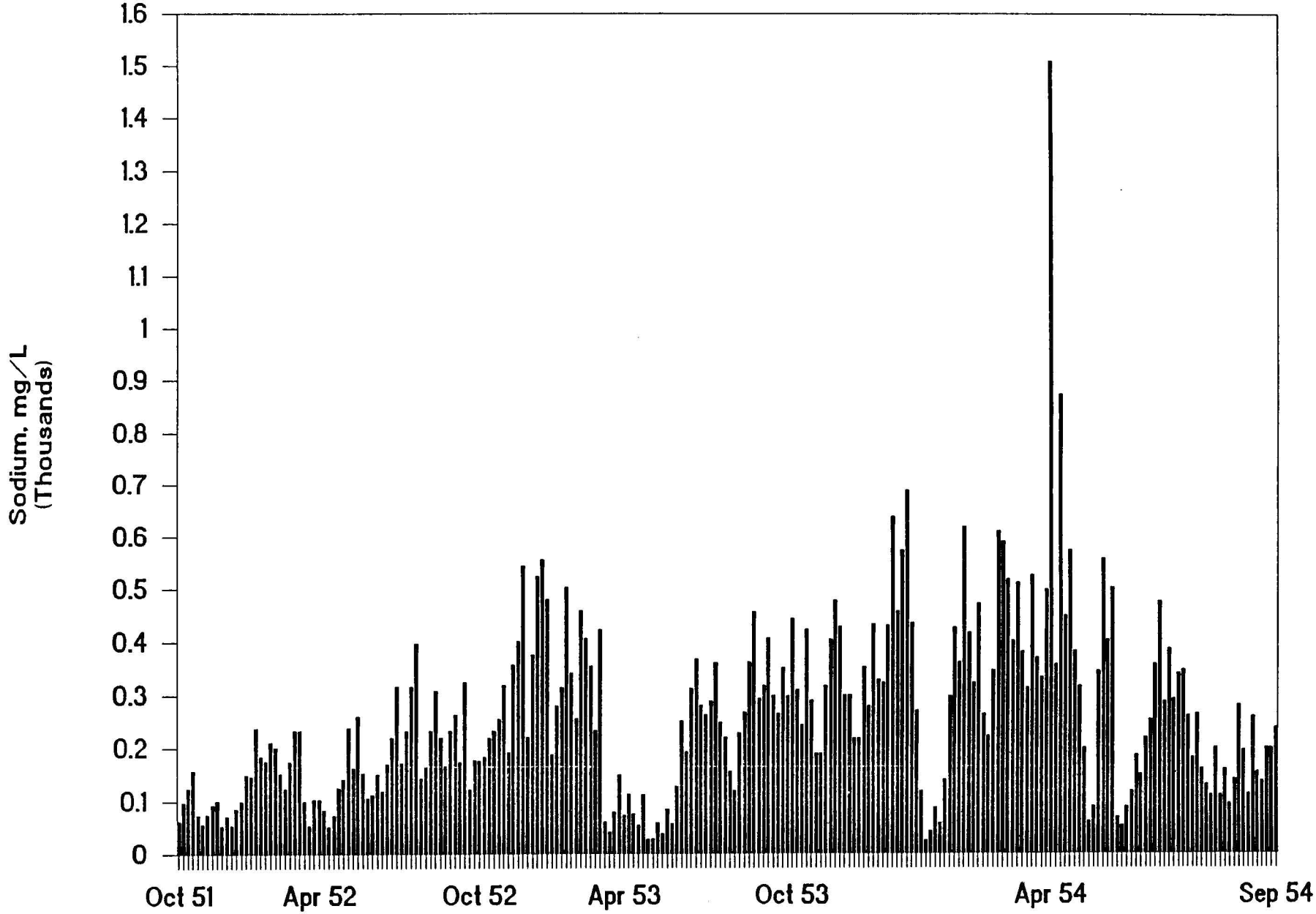

Figure 57. Graph of Sodium Versus Time For The Van Buren Site 1951-1954.

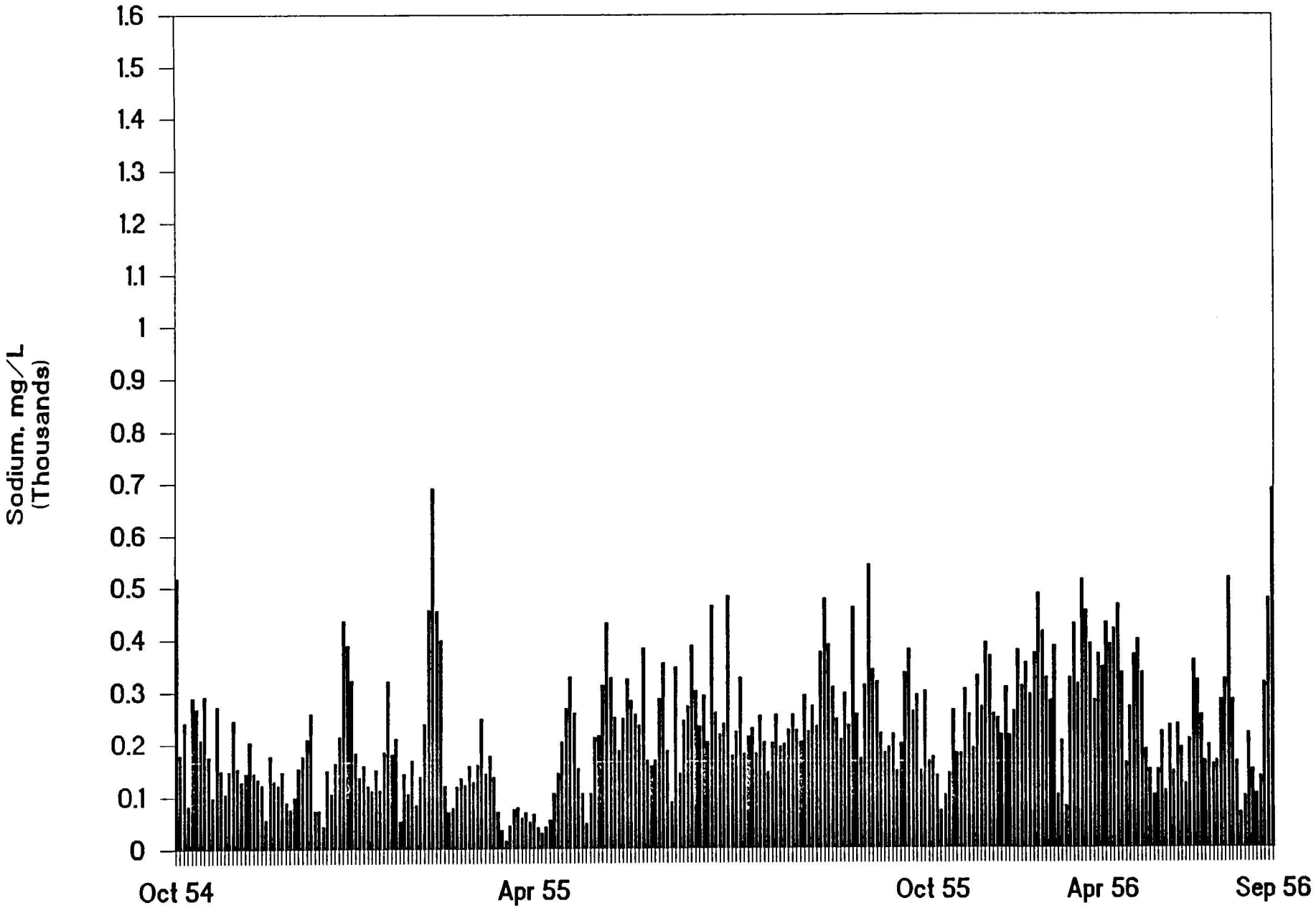

Figure 58. Graph of Sodium Versus Time For The Van Buren Site 1954-1956.

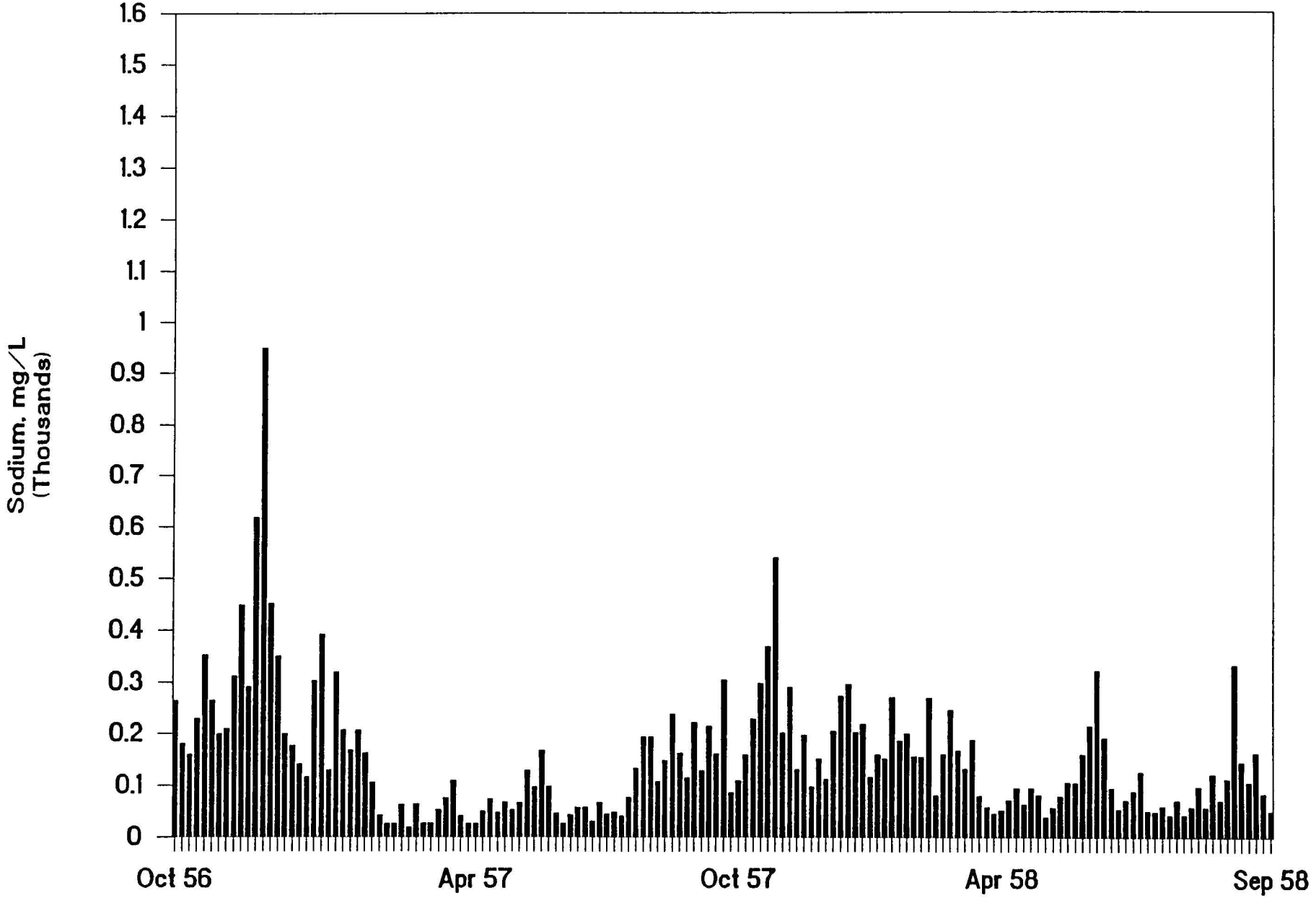

Figure 59. Graph of Sodium Versus Time For The Van Buren Site 1956-1958.

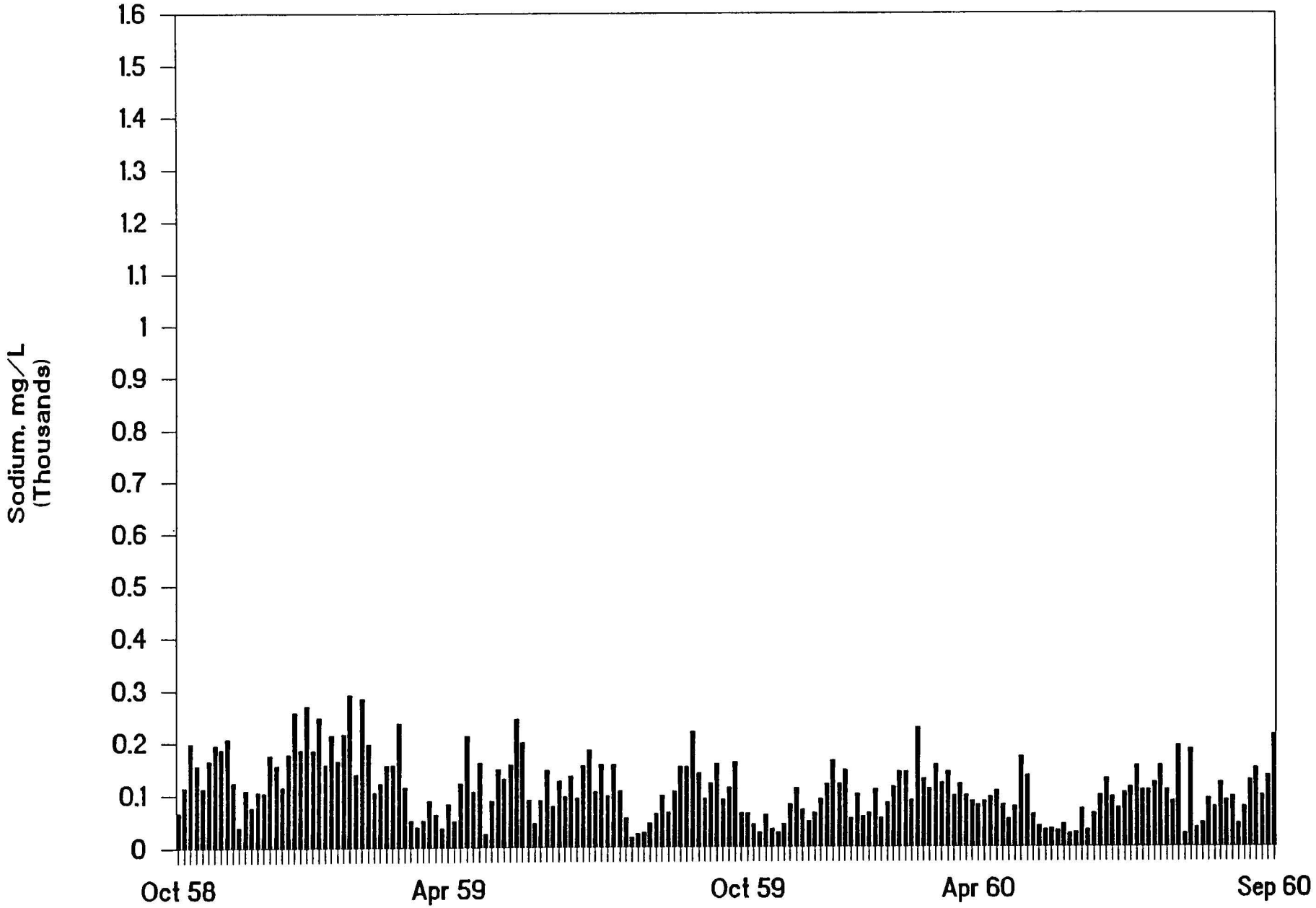

Figure 60. Graph of Sodium Versus Time For The Van Buren Site 1958-1960.

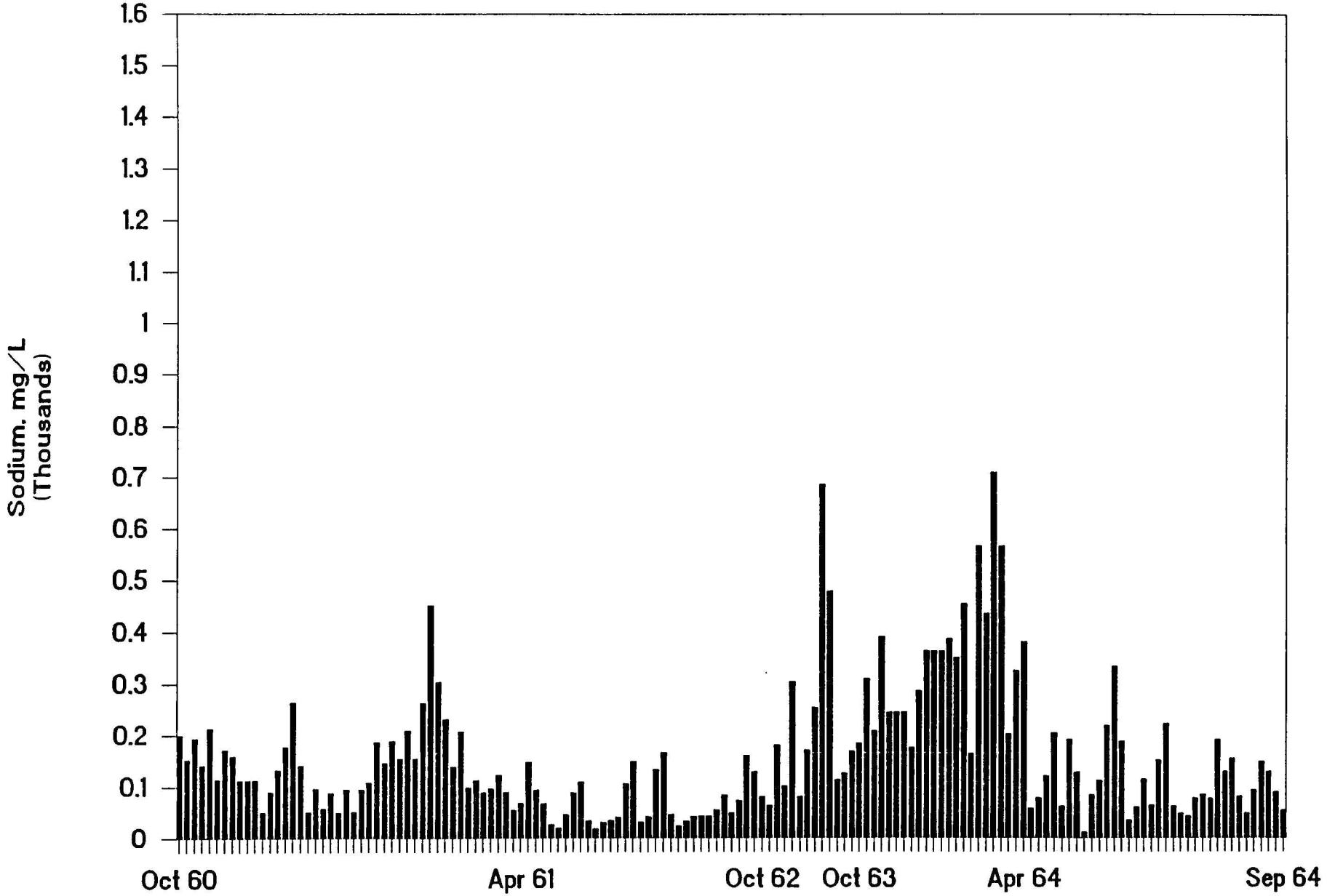

Figure 61. Graph of Sodium Versus Time For The Van Buren Site 1960-1964.

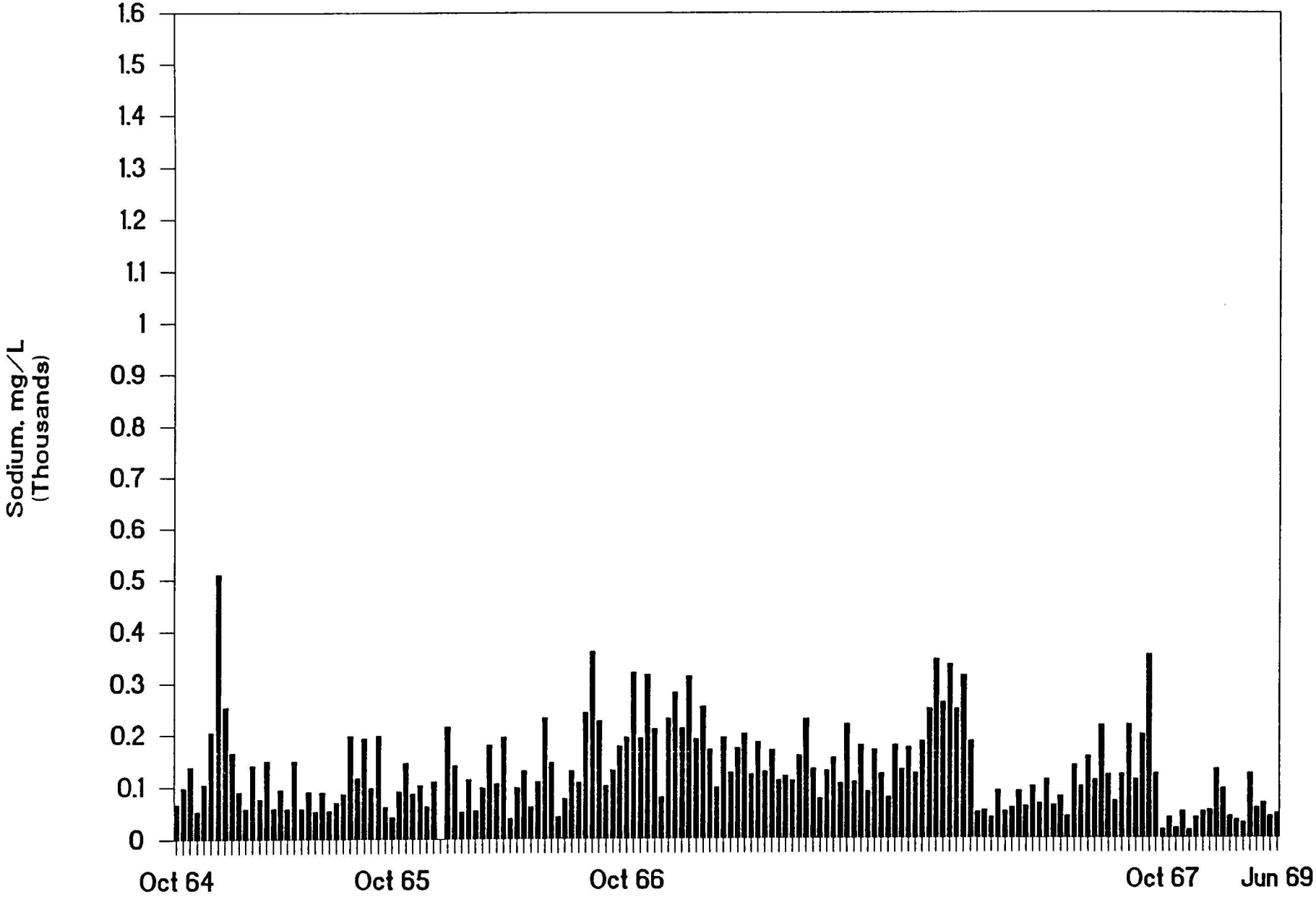

Figure 62. Graph of Sodium Versus Time For The Van Buren Site 1964-1969.

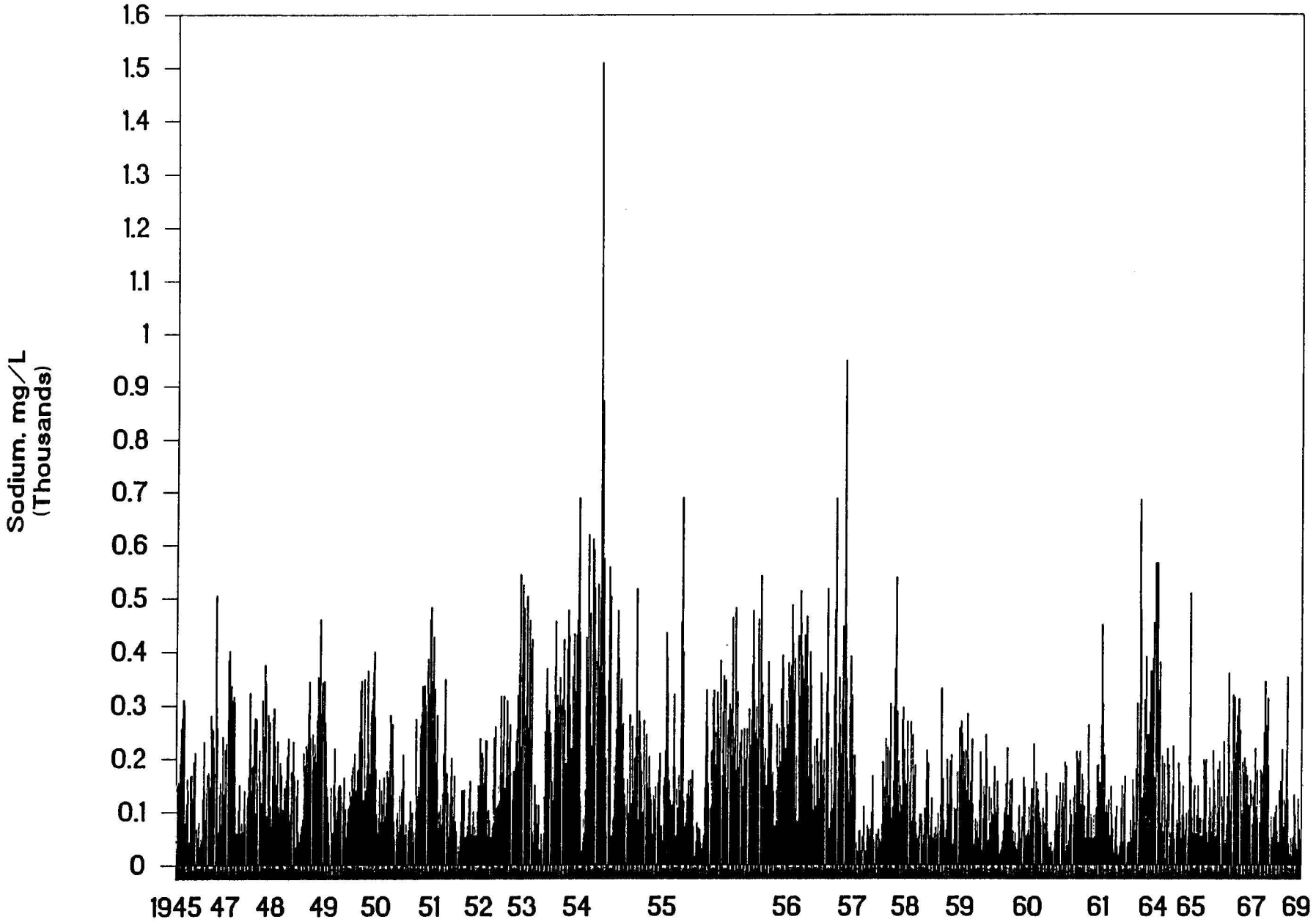

Figure 63. Graph of Sodium Versus Time For The Van Buren Site 1945-1969.

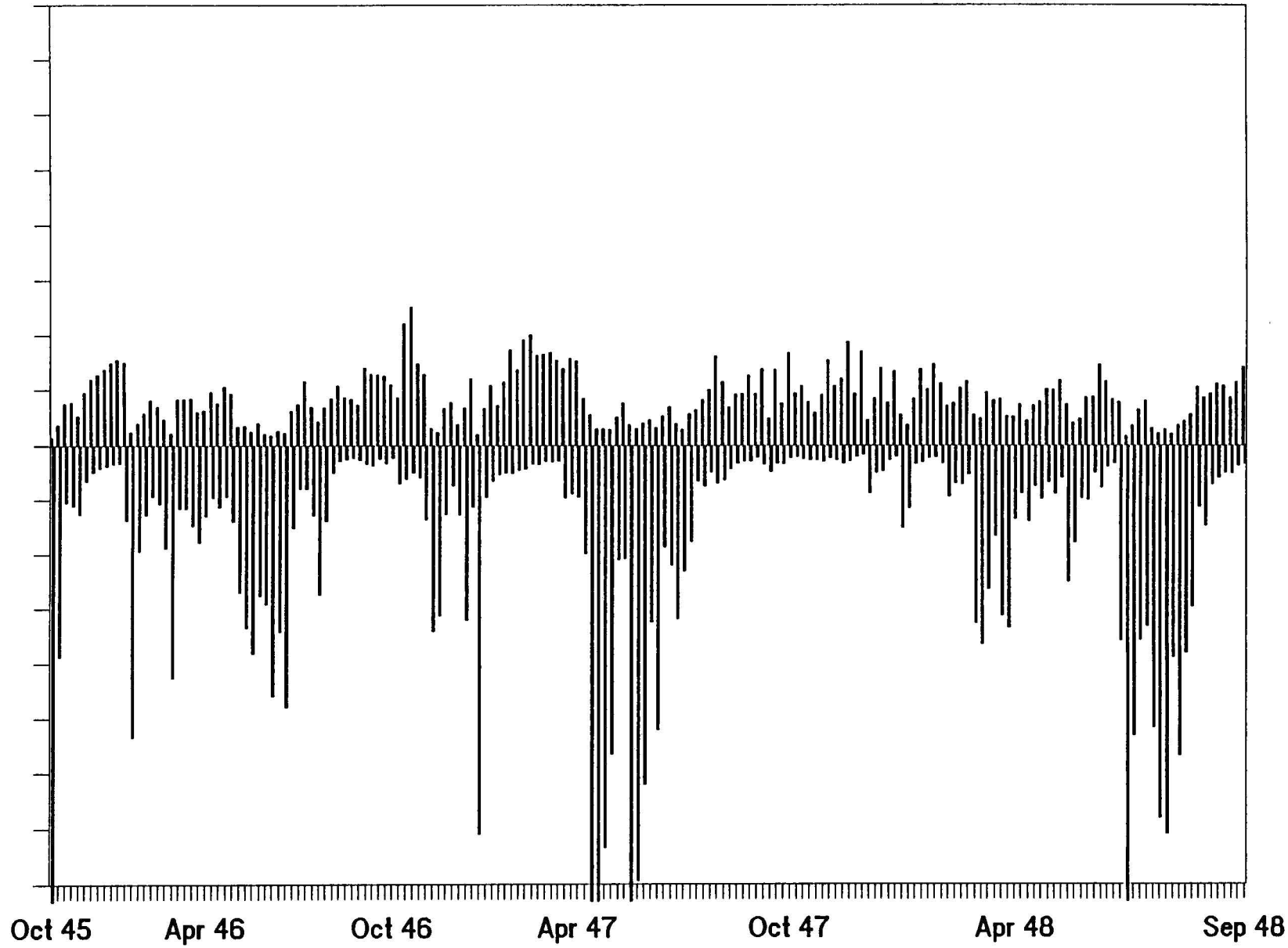

Figure 64. Graph of Sodium And Flow Versus Time For The Van Buren Site 1945-1948.

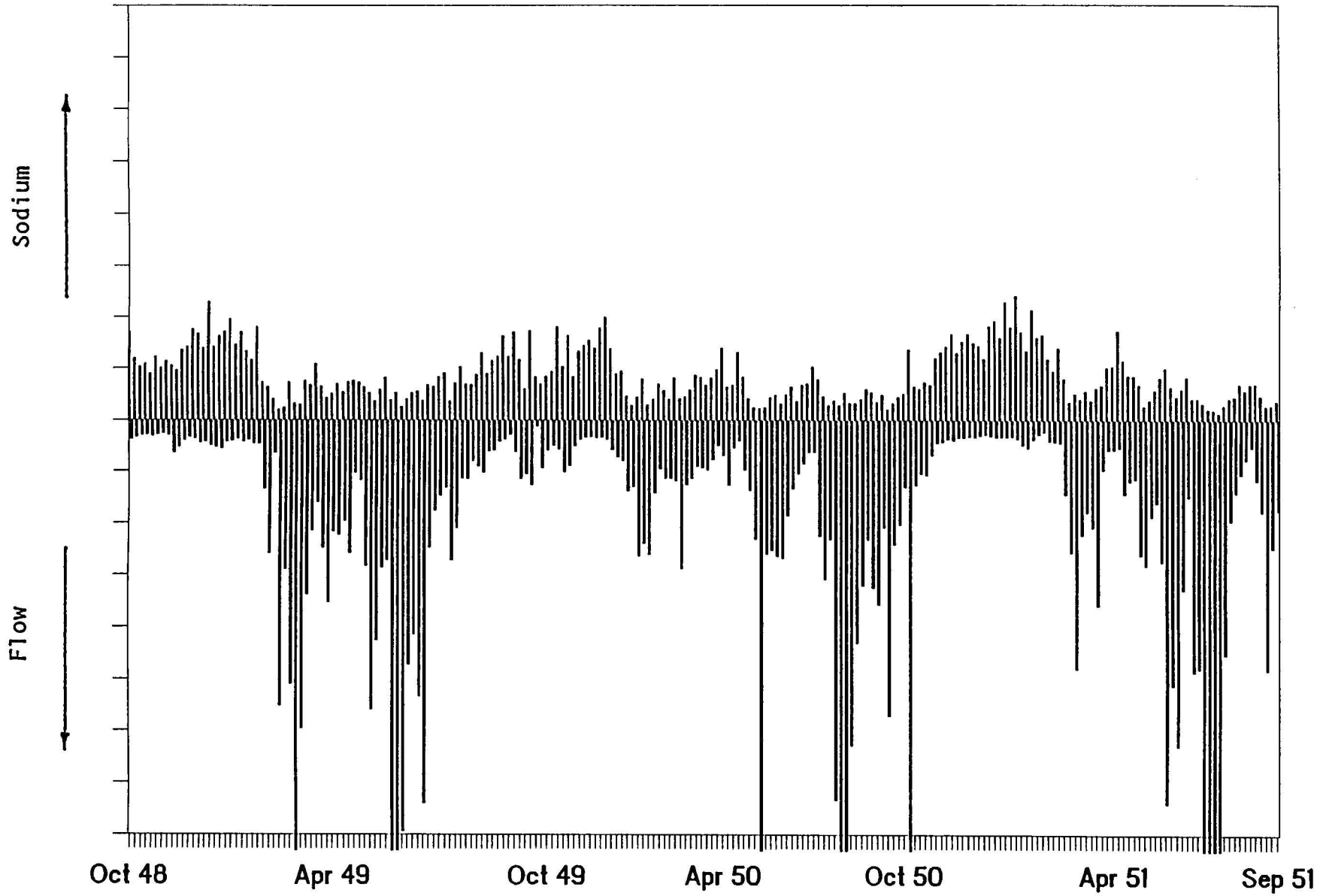

Figure 65. Graph of Sodium And Flow Versus Time For The Van Buren Site 1948-1951.

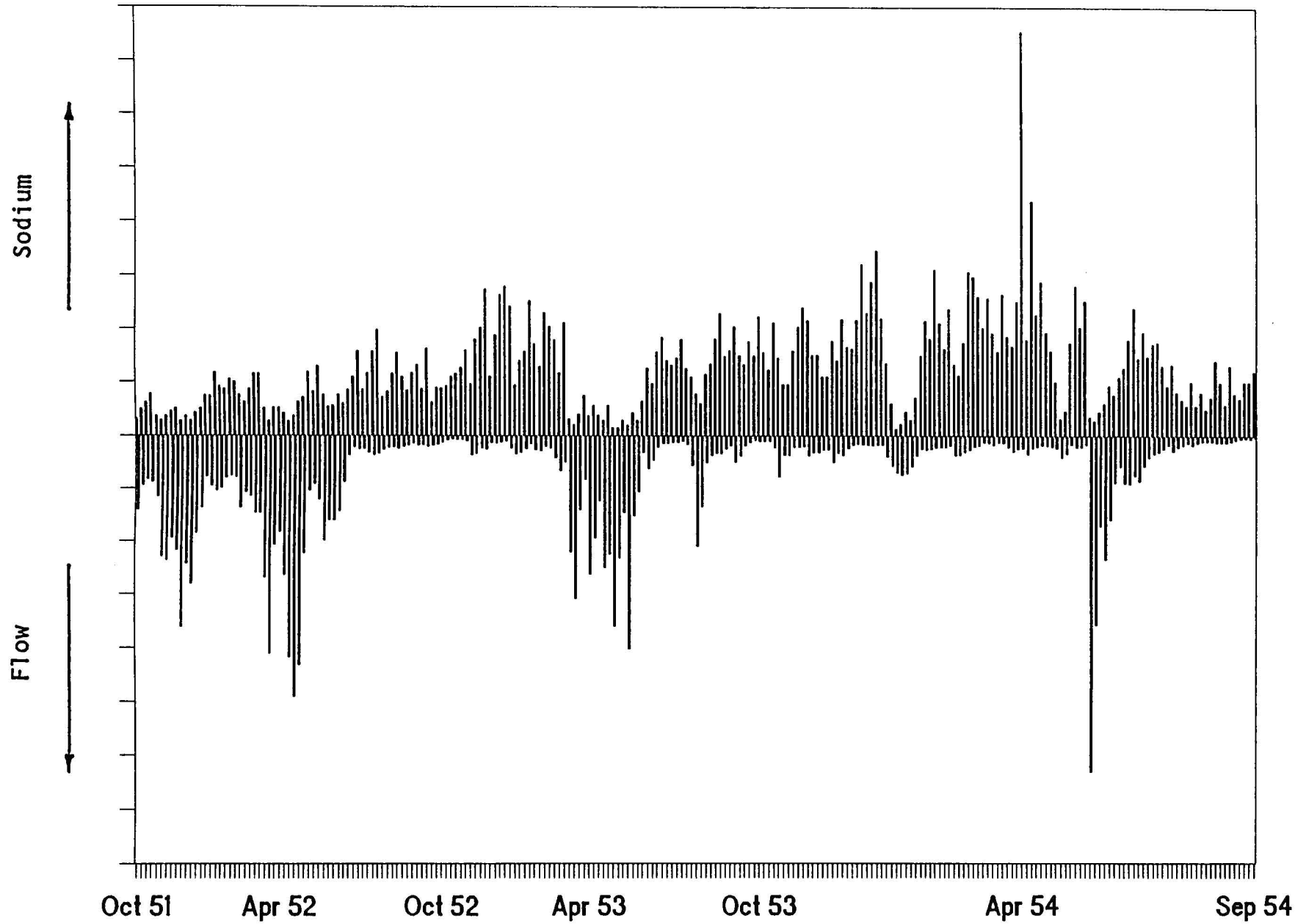

Figure 66. Graph of Sodium And Flow Versus Time For The Van Buren Site 1951-1954.

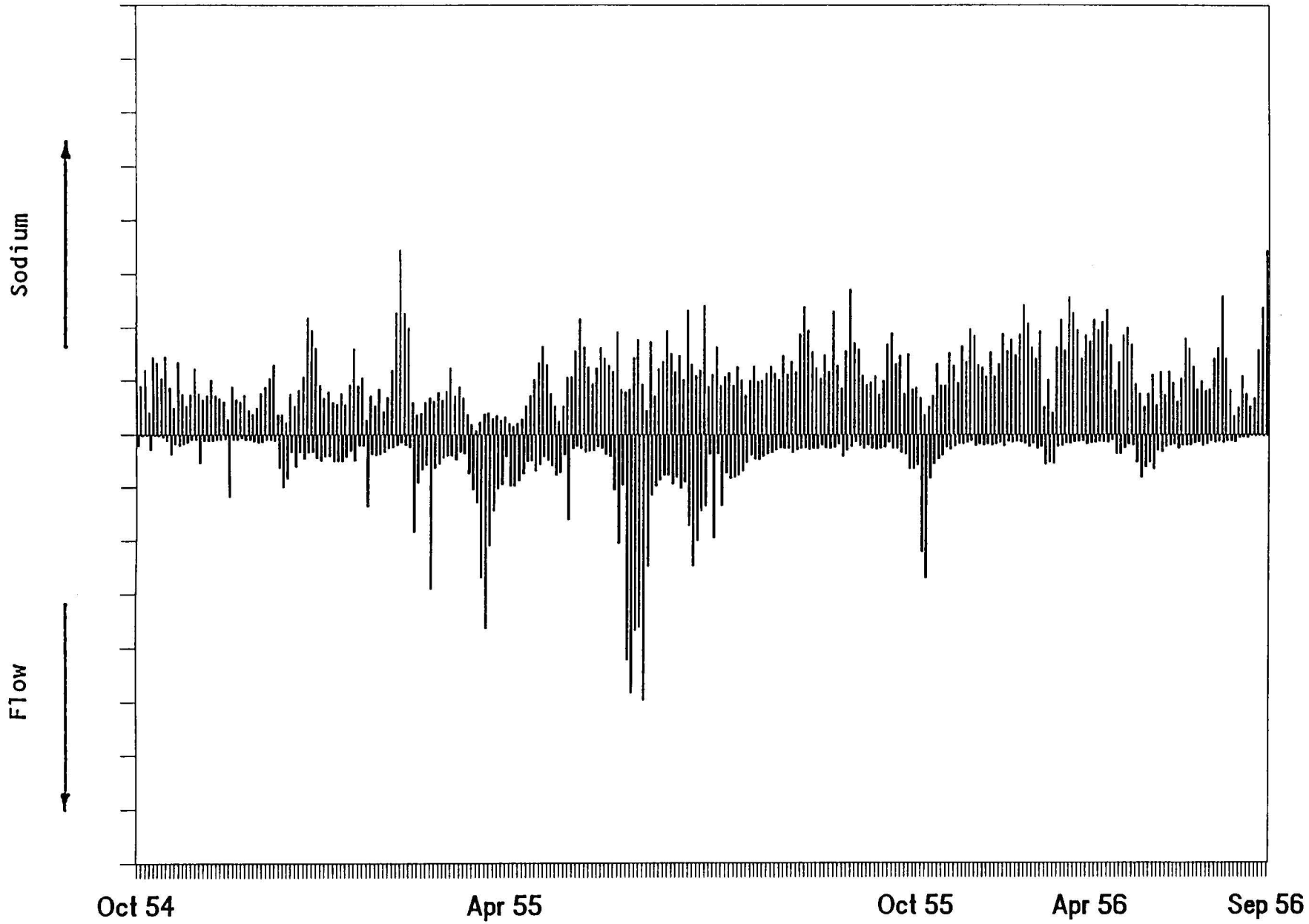

Figure 67. Graph of Sodium And Flow Versus Time For The Van Buren Site 1954-1956.

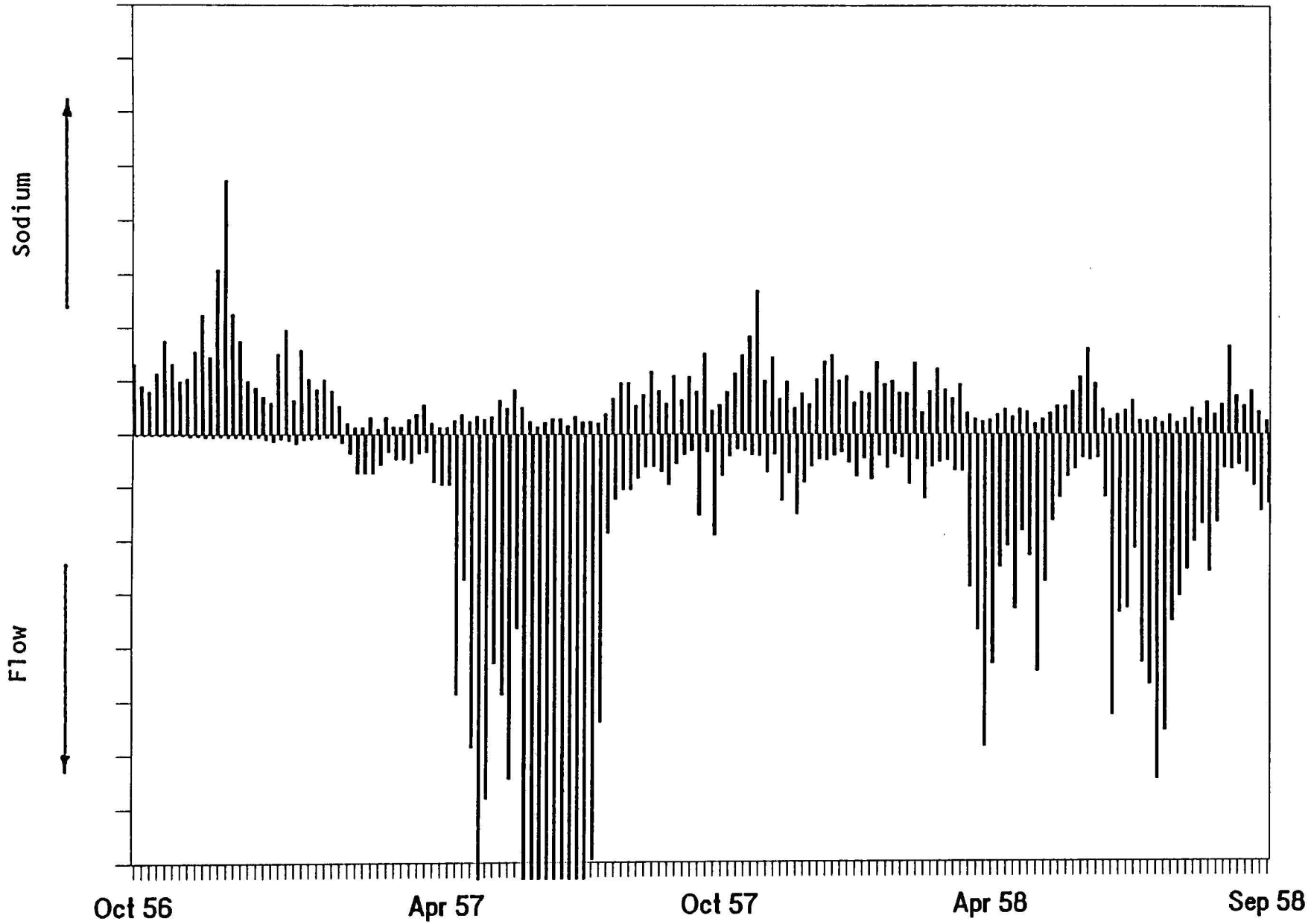

Figure 68. Graph of Sodium And Flow Versus Time For The Van Buren Site 1956-1958.

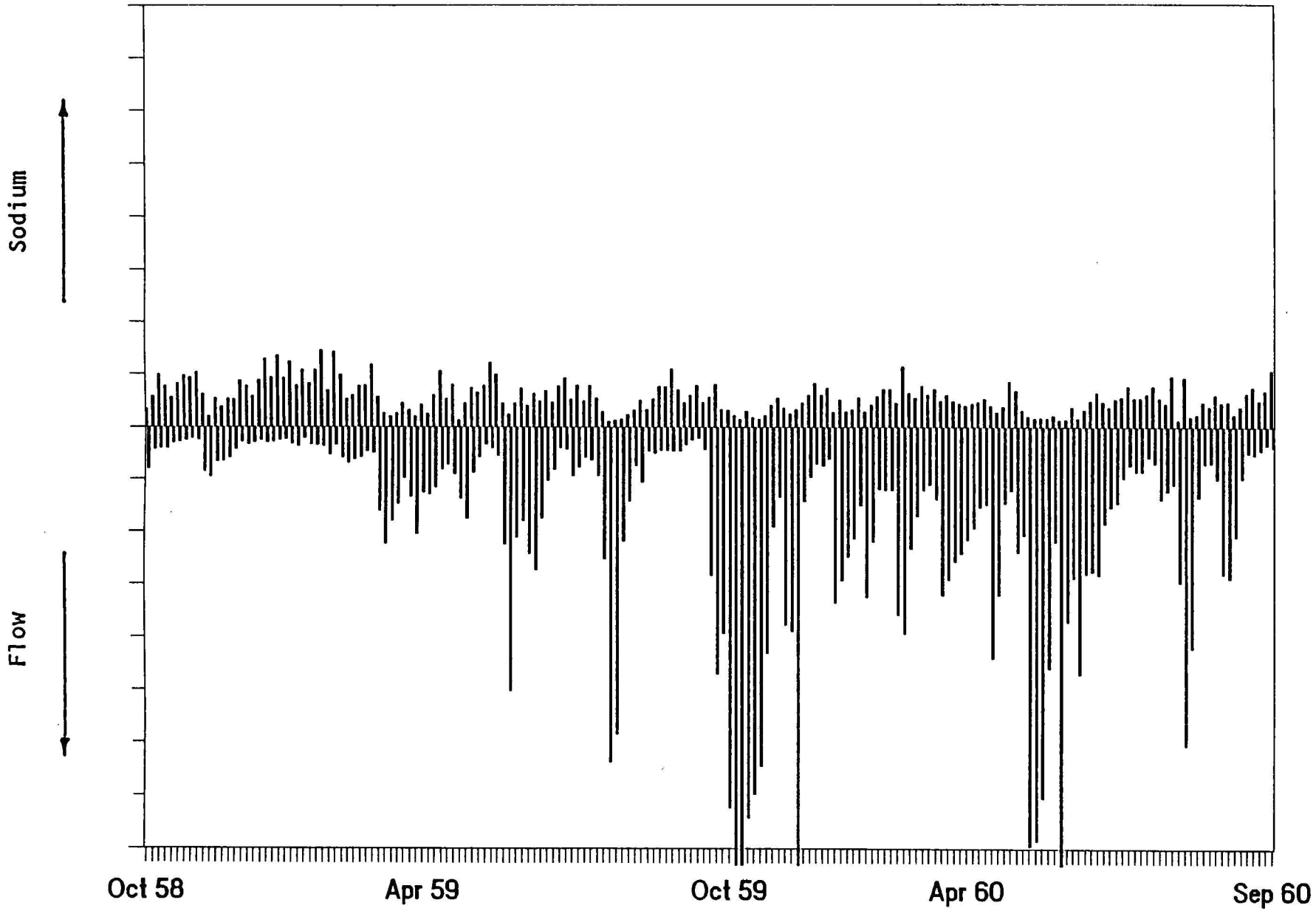

Figure 69. Graph of Sodium And Flow Versus Time For The Van Buren Site 1958-1960.

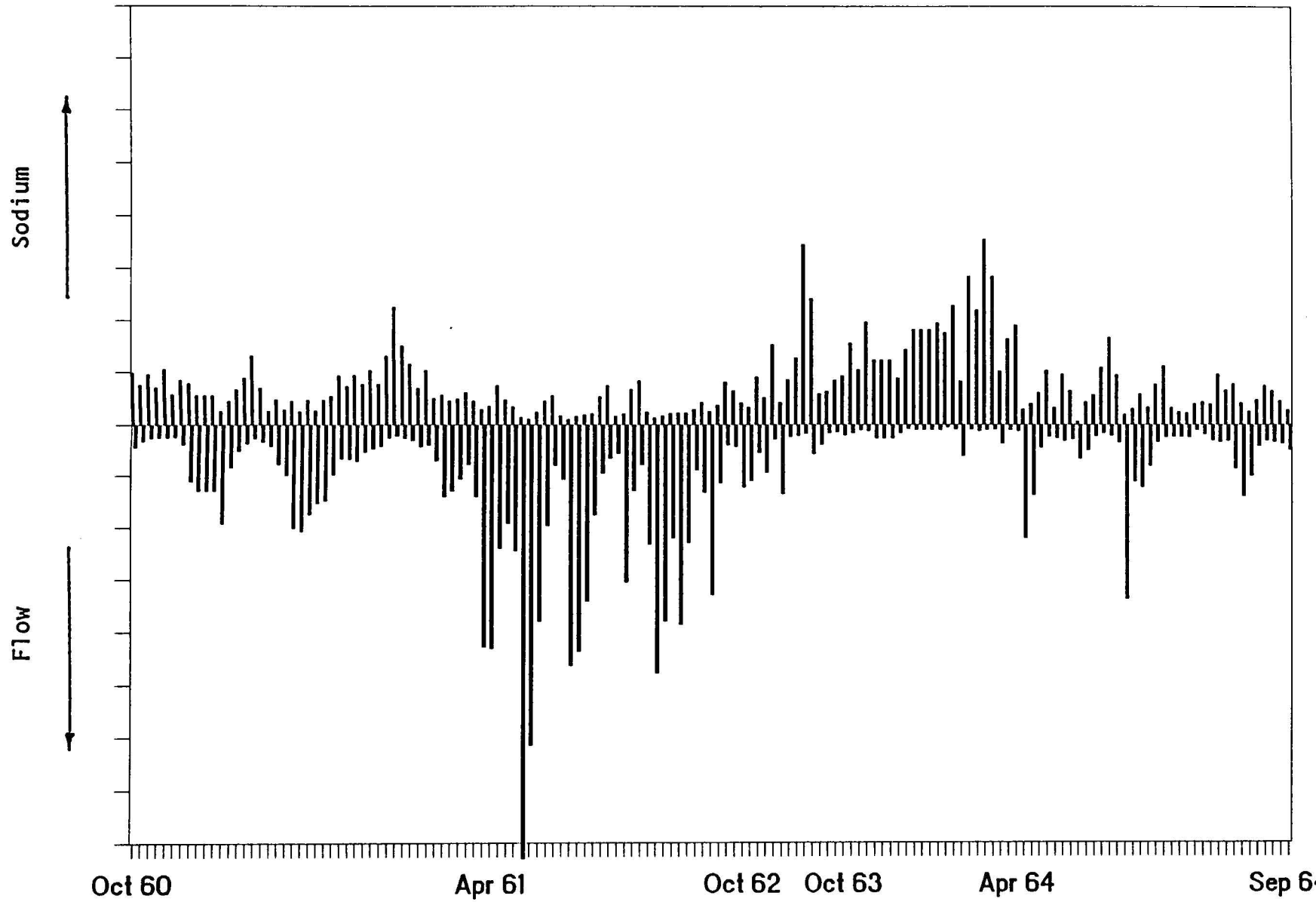

Figure 70. Graph of Sodium And Flow Versus Time For The Van Buren Site 1960-1964.

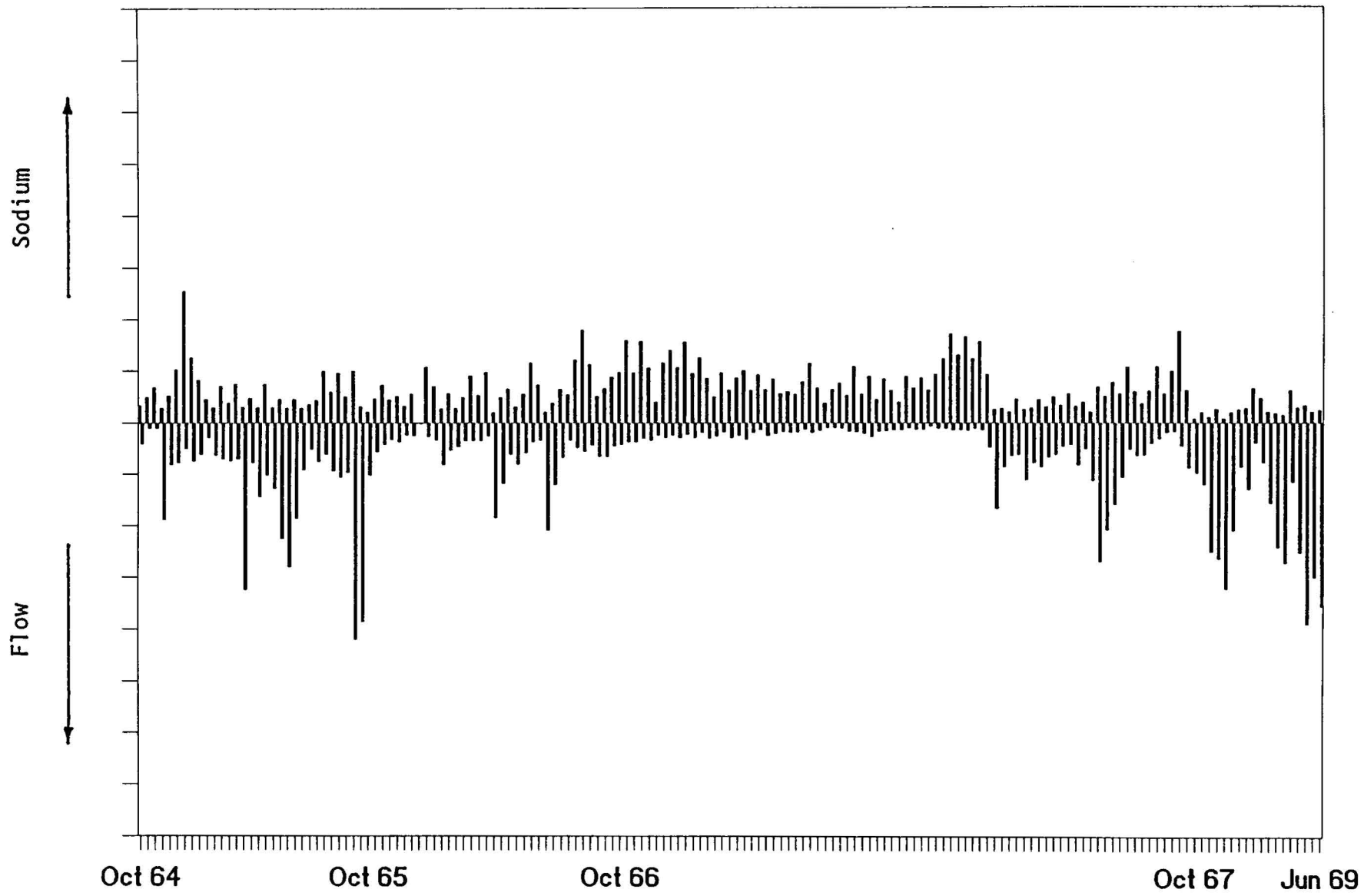

Figure 71. Graph of Sodium And Flow Versus Time For The Van Buren Site 1964-1969.

Suspended Solids. The suspended solids data for the Van Buren site are plotted in Figure 72. The average suspended solids concentration was 38 mg/L for the period from 1974 until 1986. The minimum and maximum concentrations were 3 and 313 mg/L, respectively. Both flow and suspended solids concentrations are shown in Figure 73 as a function of time.

Sulfate. The sulfate data for the Van Buren site are shown in Figures 74 through 83. Figures 74 through 81 show the data plotted on relatively short-term cycles to allow examination for seasonal variations. Figure 82 shows the data from 1974 through 1986. Figure 83 is a combined graph of all data from 1945 until 1969. The average sulfate concentrations were 68 and 46 mg/L, respectively, for the periods of record from 1945 until 1969 and from 1975 through 1986. The maximum concentration in the earlier data was 214 mg/L and the minimum sulfate concentration was 6 mg/L. Concerning the period of record from 1969 through 1986, the minimum and maximum concentrations were 19 and 95 mg/L, respectively.

Figures 84 through 92 show the sulfate concentrations plotted with flow versus time for the 1945 through 1969 and 1975 through 1986 time periods. As indicated by the figures, there was a much more apparent tendency for larger sulfate concentrations at lower flow rates during the period of time from 1945 until 1969 than for the 1975 through 1986 time period.

Total Hardness. The average total hardness concentrations were 120 and 217 mg/L, respectively for the 1974 through

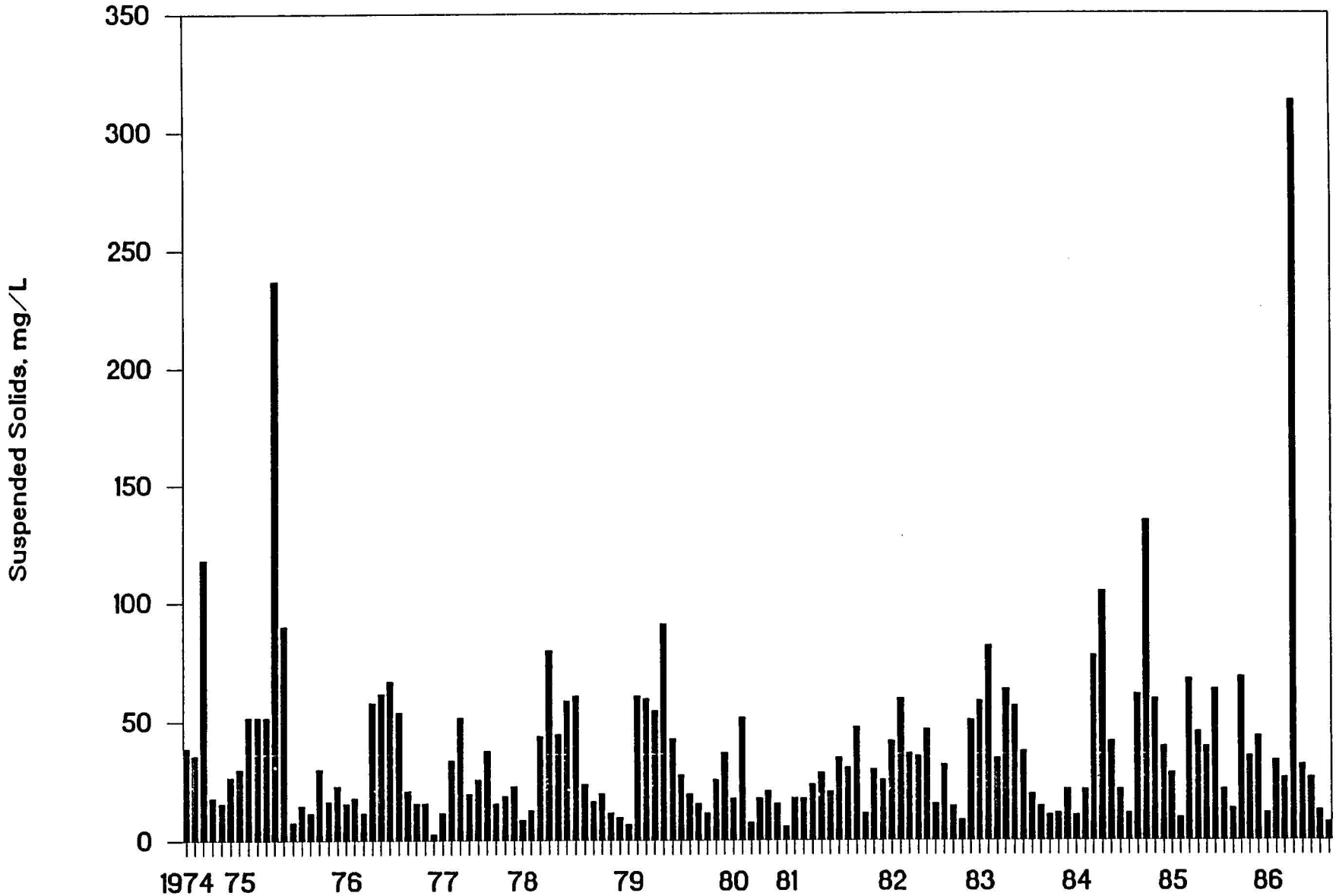

Figure 72. Graph of Suspended Solids Versus Time For The Van Buren Site 1974-1986.

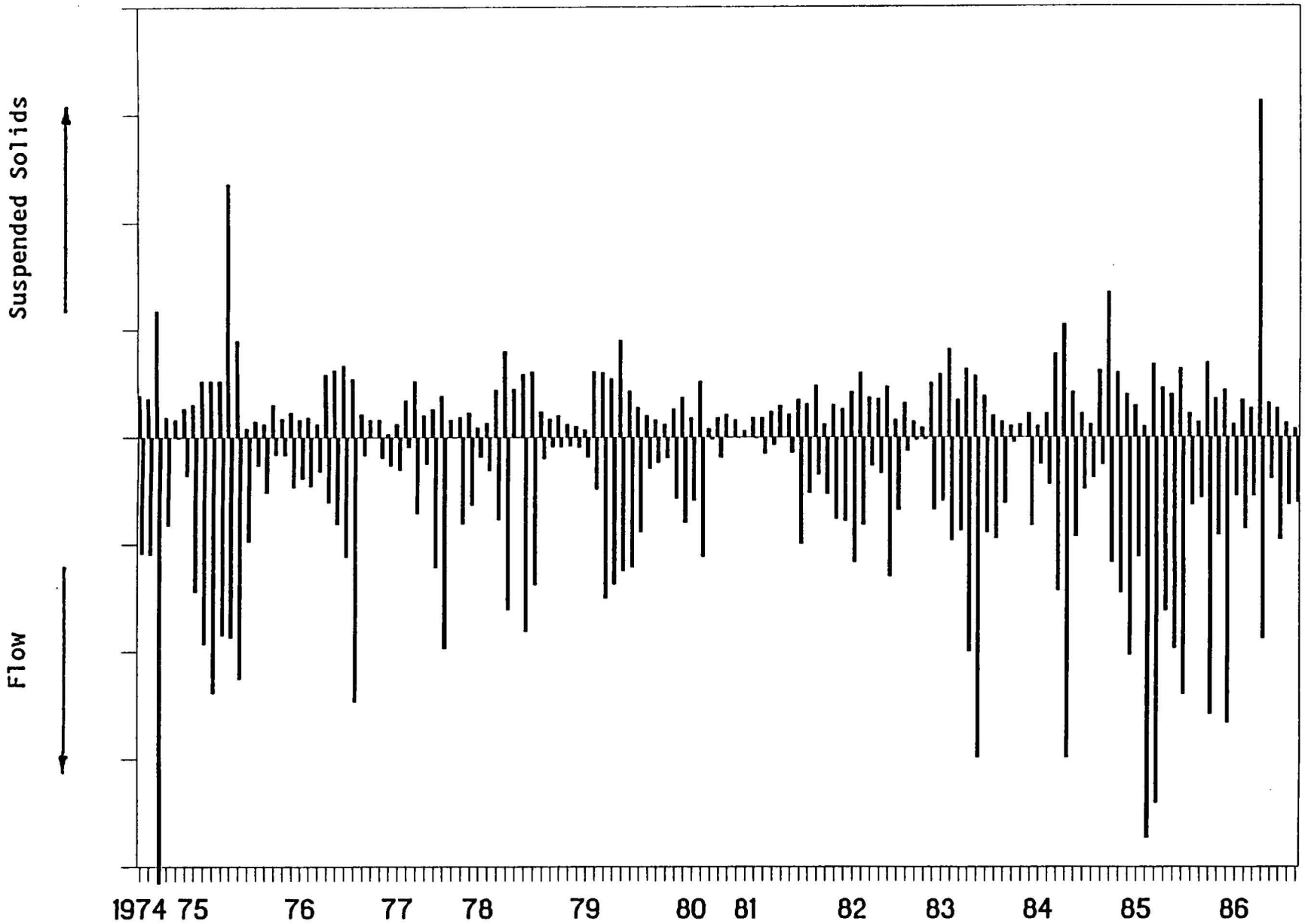

Figure 73. Graph of Suspended Solids And Flow Versus Time For The Van Buren Site 1974-1986.

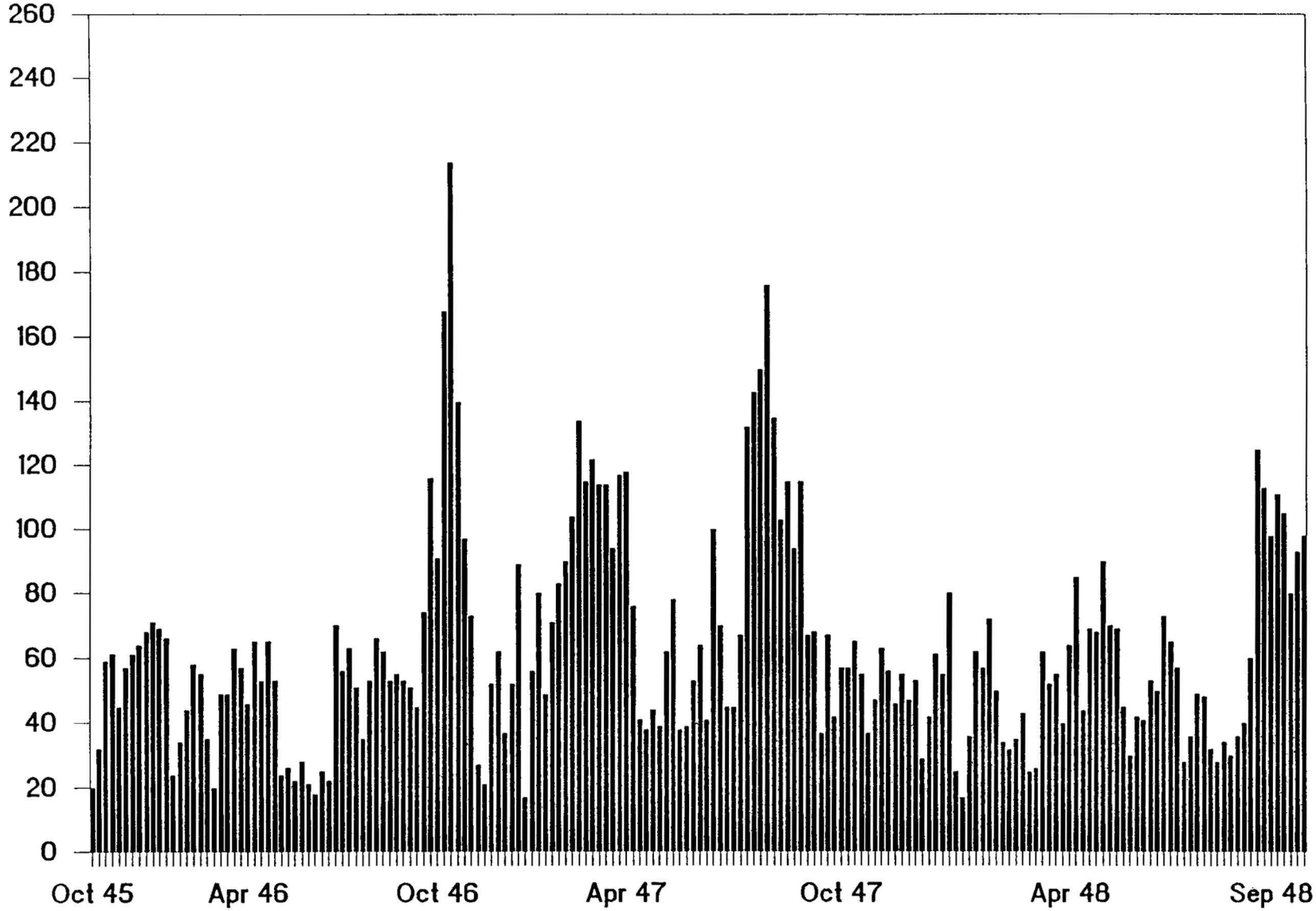

Figure 74. Graph of Sulfate Versus Time For The Van Buren Site 1945-1948.

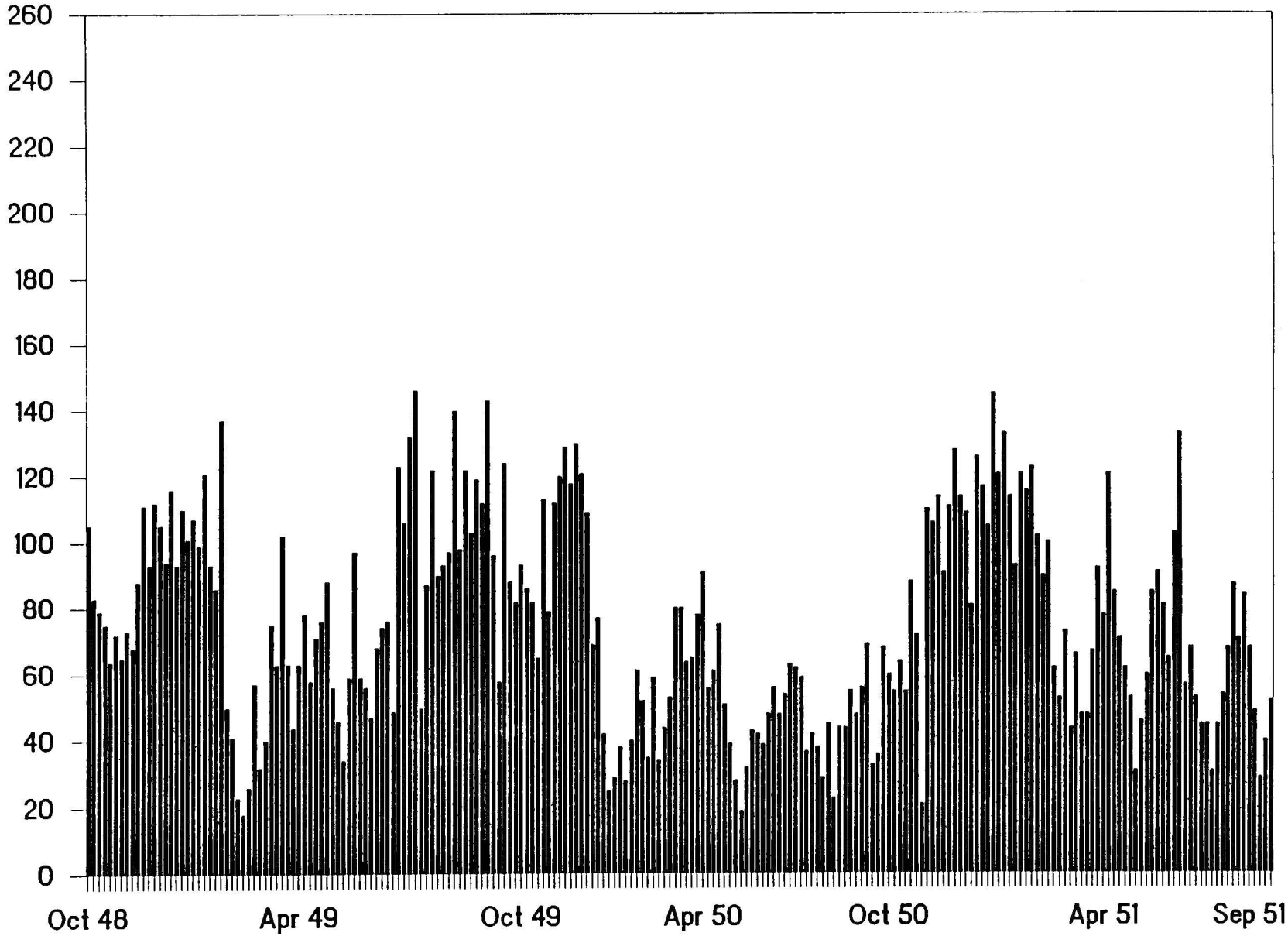

Figure 75. Graph of Sulfate Versus Time For The Van Buren Site 1948-1951.

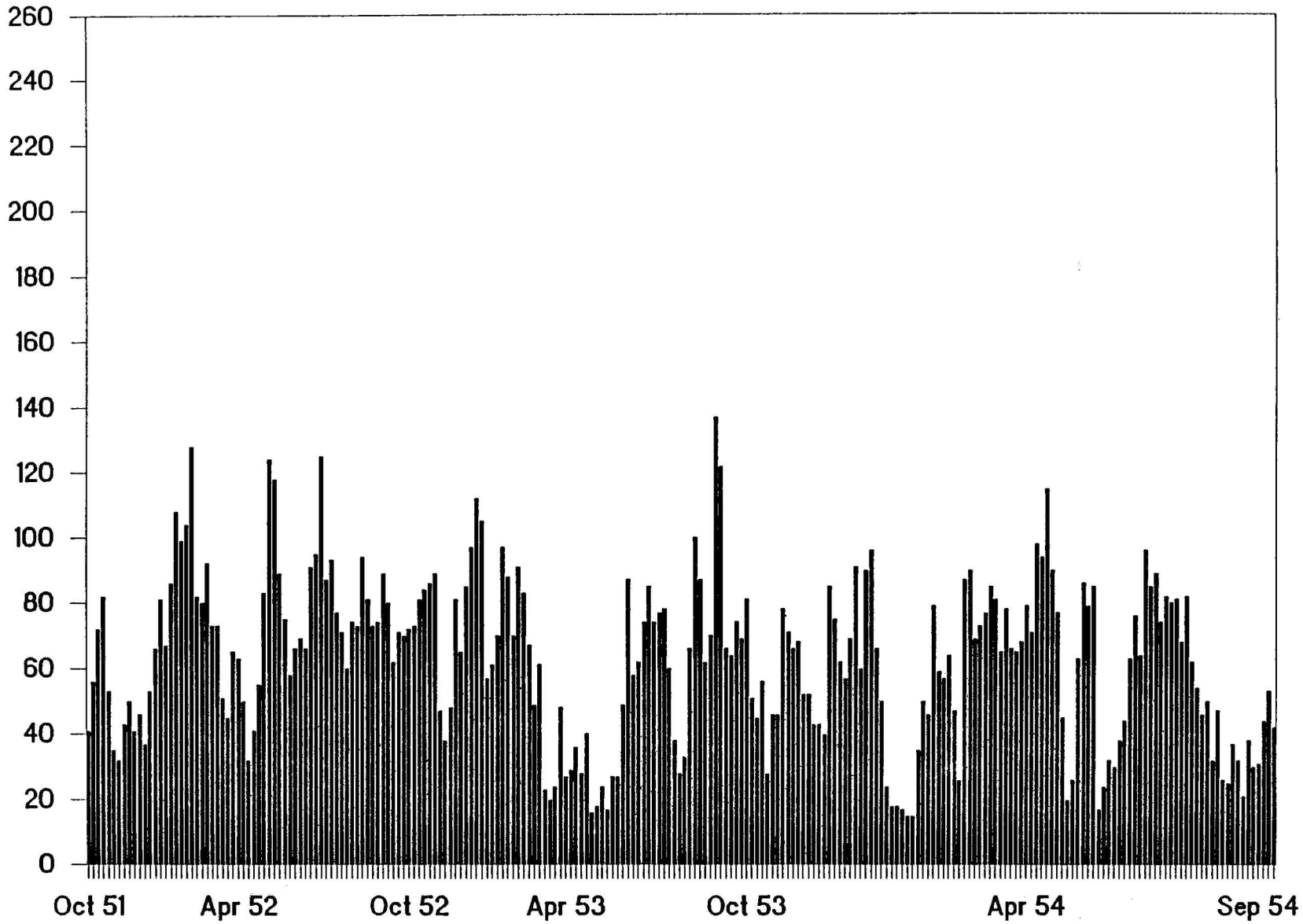

Figure 76. Graph of Sulfate Versus Time For The Van Buren Site 1951-1954.

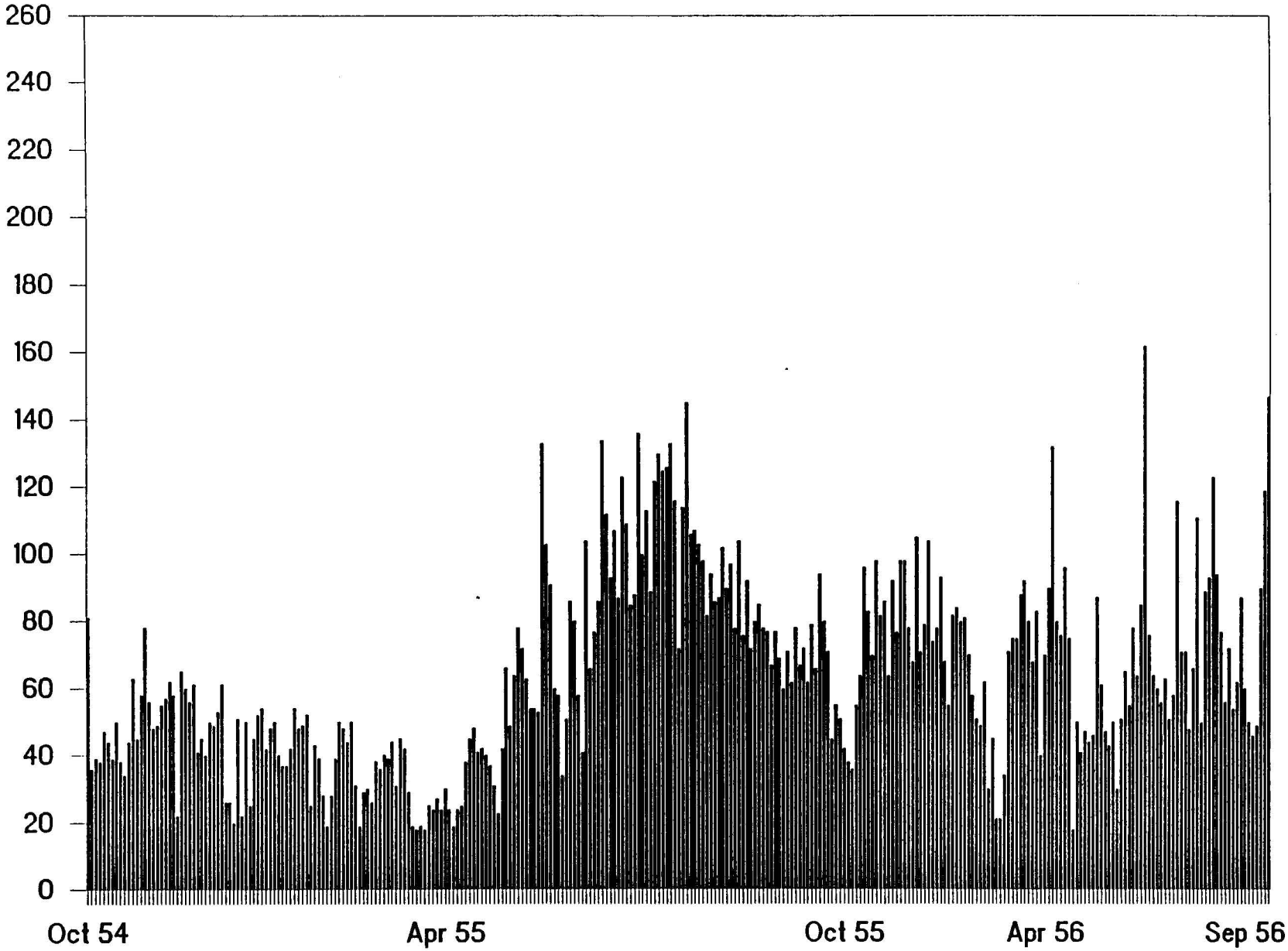

Figure 77. Graph of Sulfate Versus Time For The Van Buren Site 1954-1956.

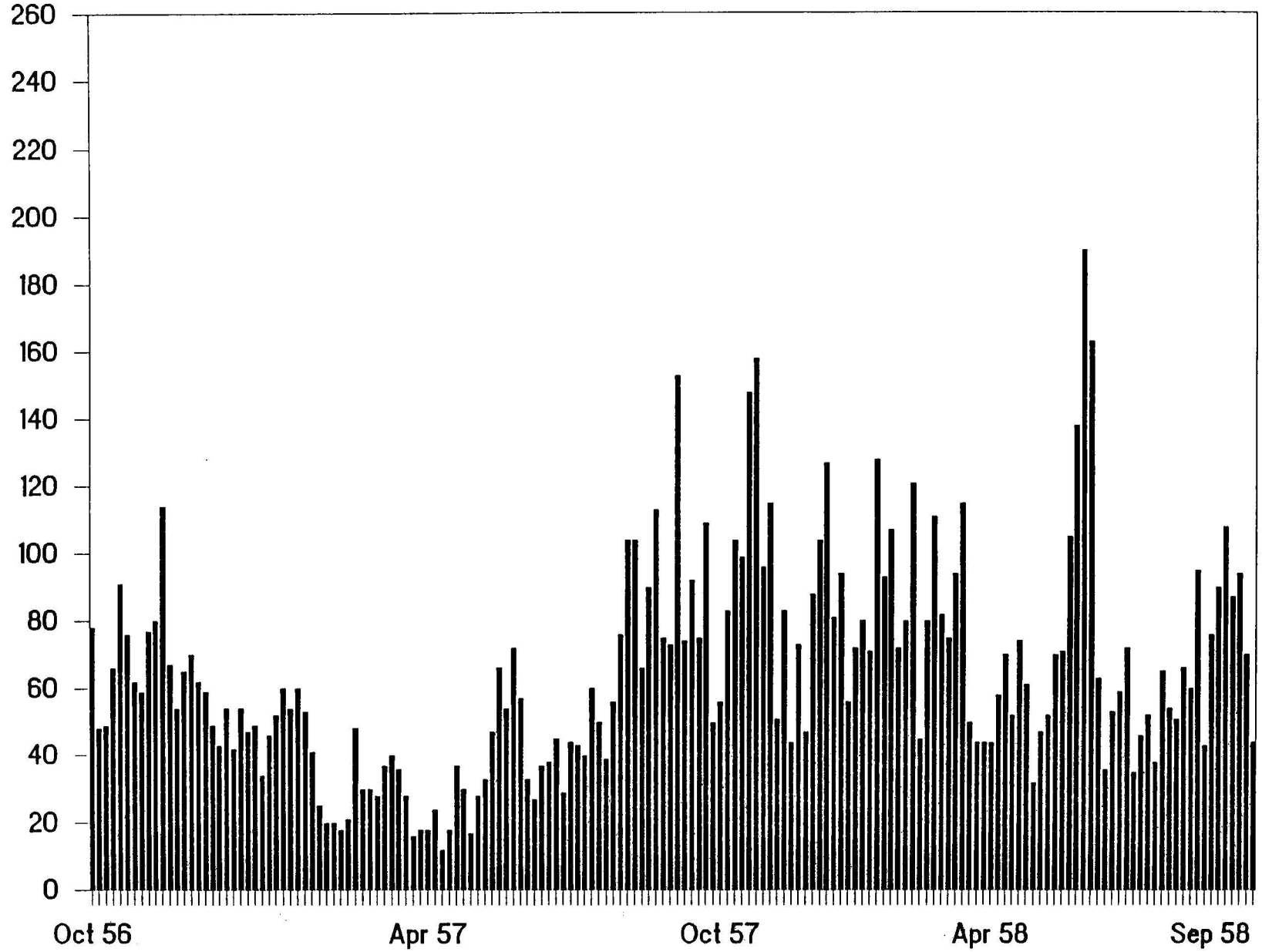

Figure 78. Graph of Sulfate Versus Time For The Van Buren Site 1956-1958.

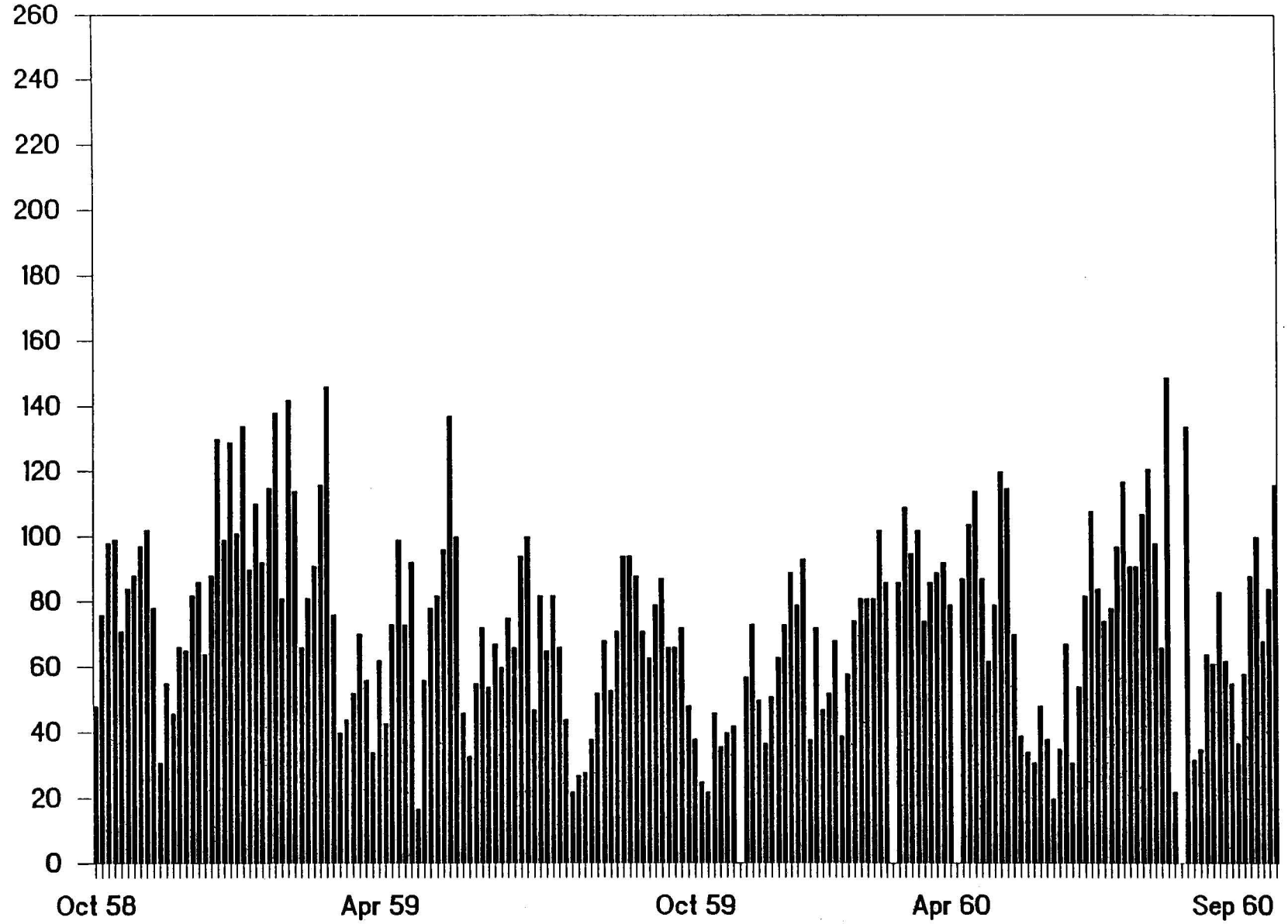

Figure 79. Graph of Sulfate Versus Time For The Van Buren Site 1958-1960.

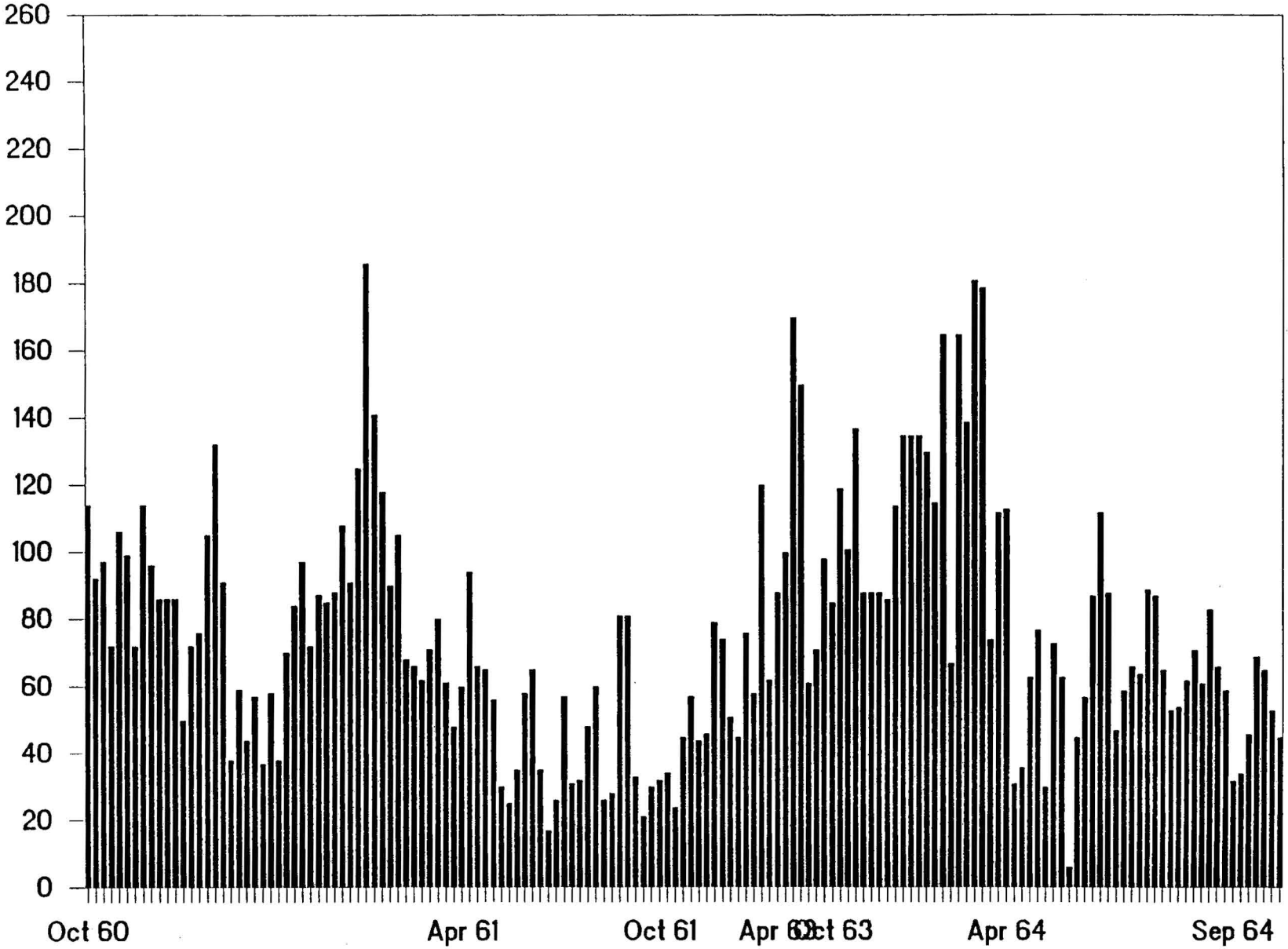

Figure 80. Graph of Sulfate Versus Time For The Van Buren Site 1960-1964.

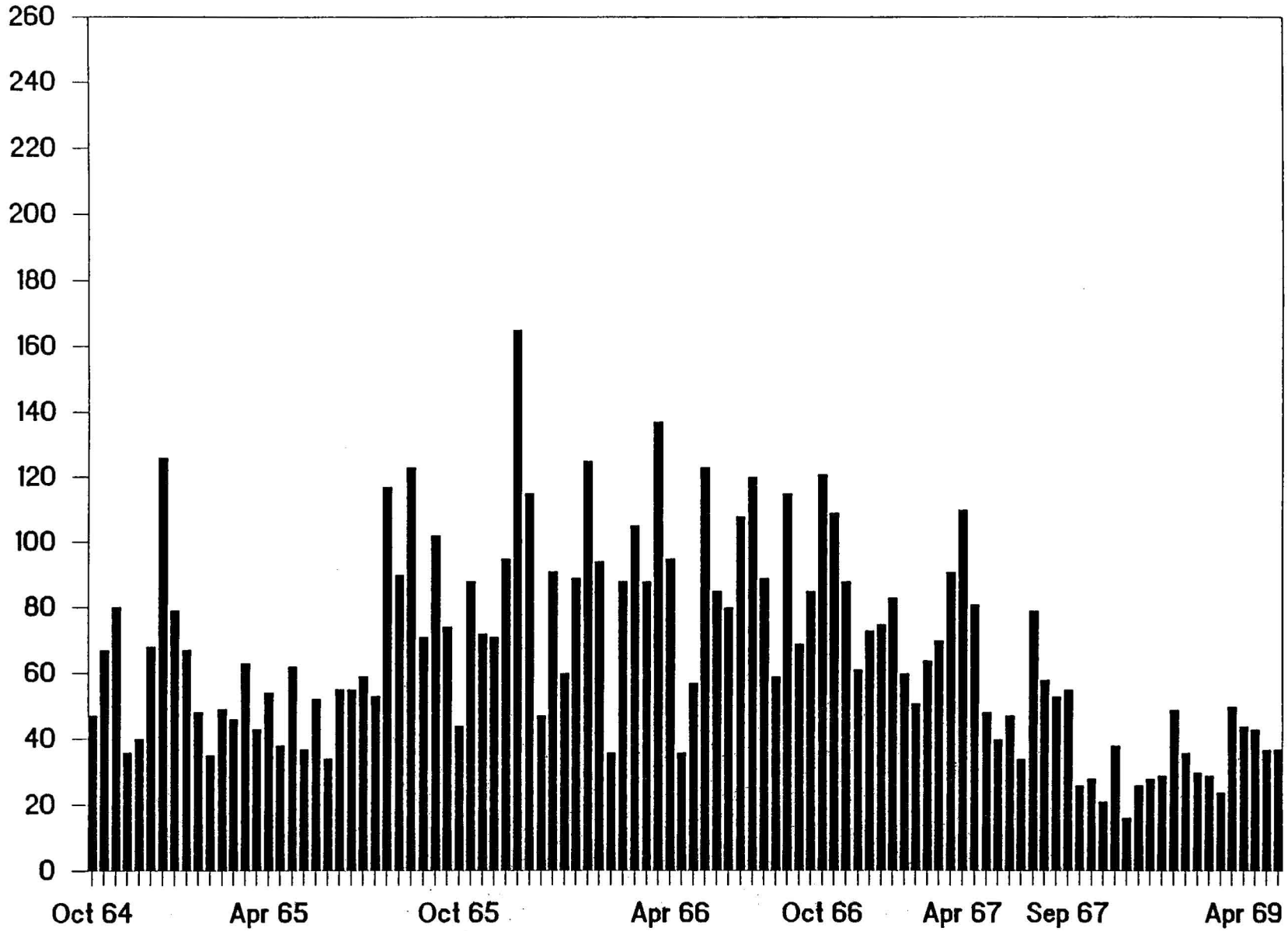

Figure 81. Graph of Sulfate Versus Time For The Van Buren Site 1964-1969.

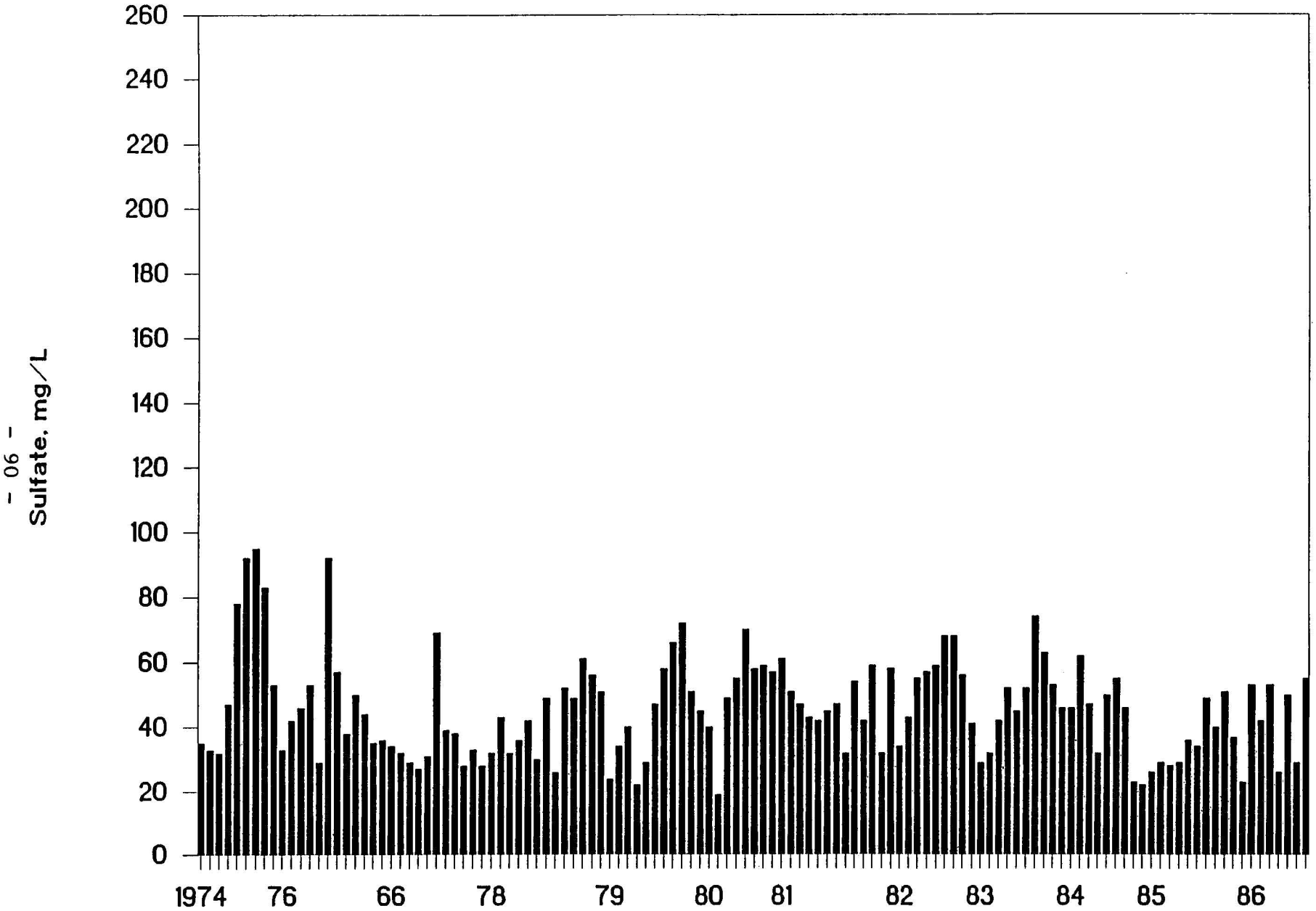

Figure 82. Graph of Sulfate Versus Time For The Van Buren Site 1974-1986.

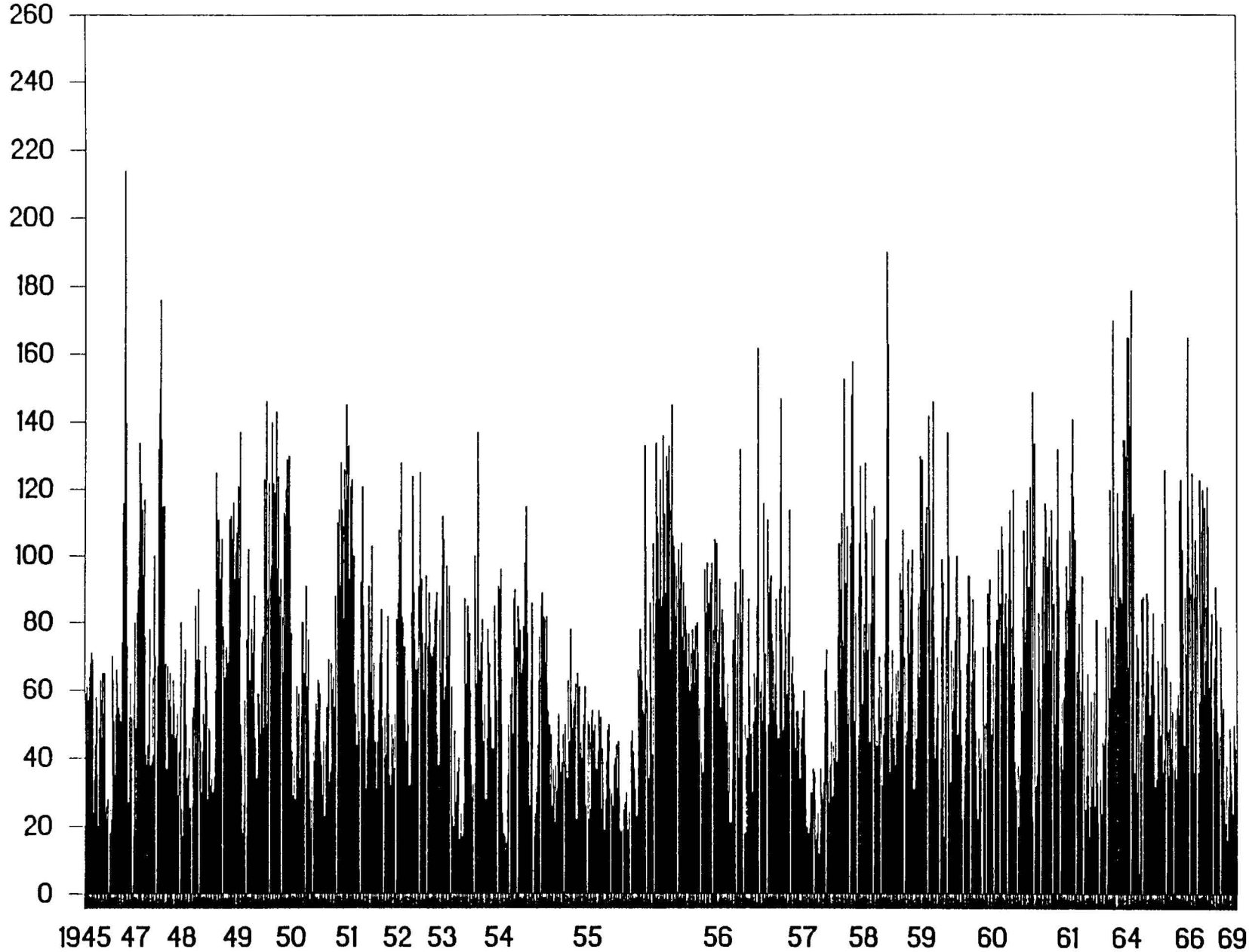

Figure 83. Graph of Sulfate Versus Time For The Van Buren Site 1945-1969.

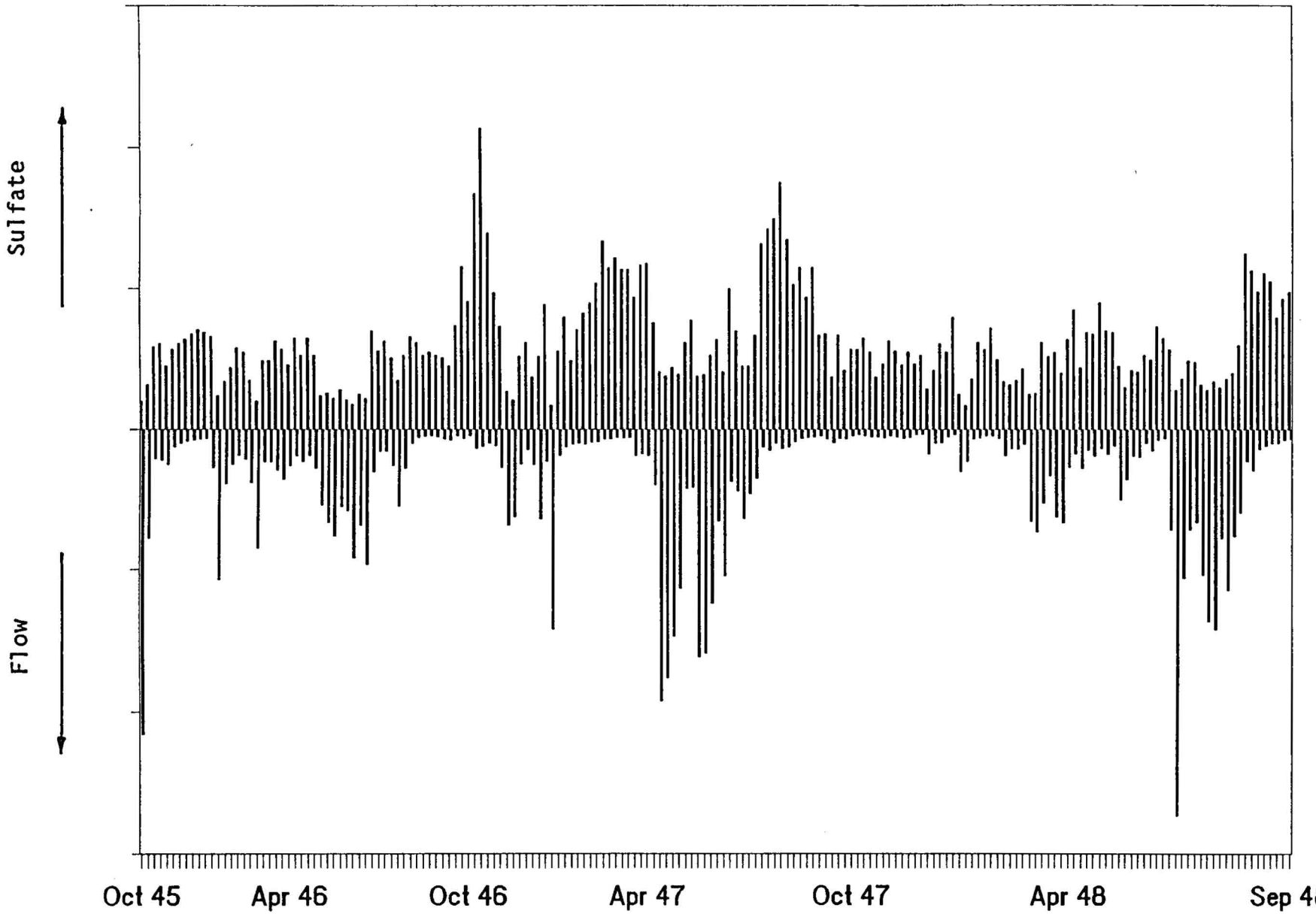

Figure 84. Graph of Sulfate And Flow Versus Time For The Van Buren Site 1945-1948.

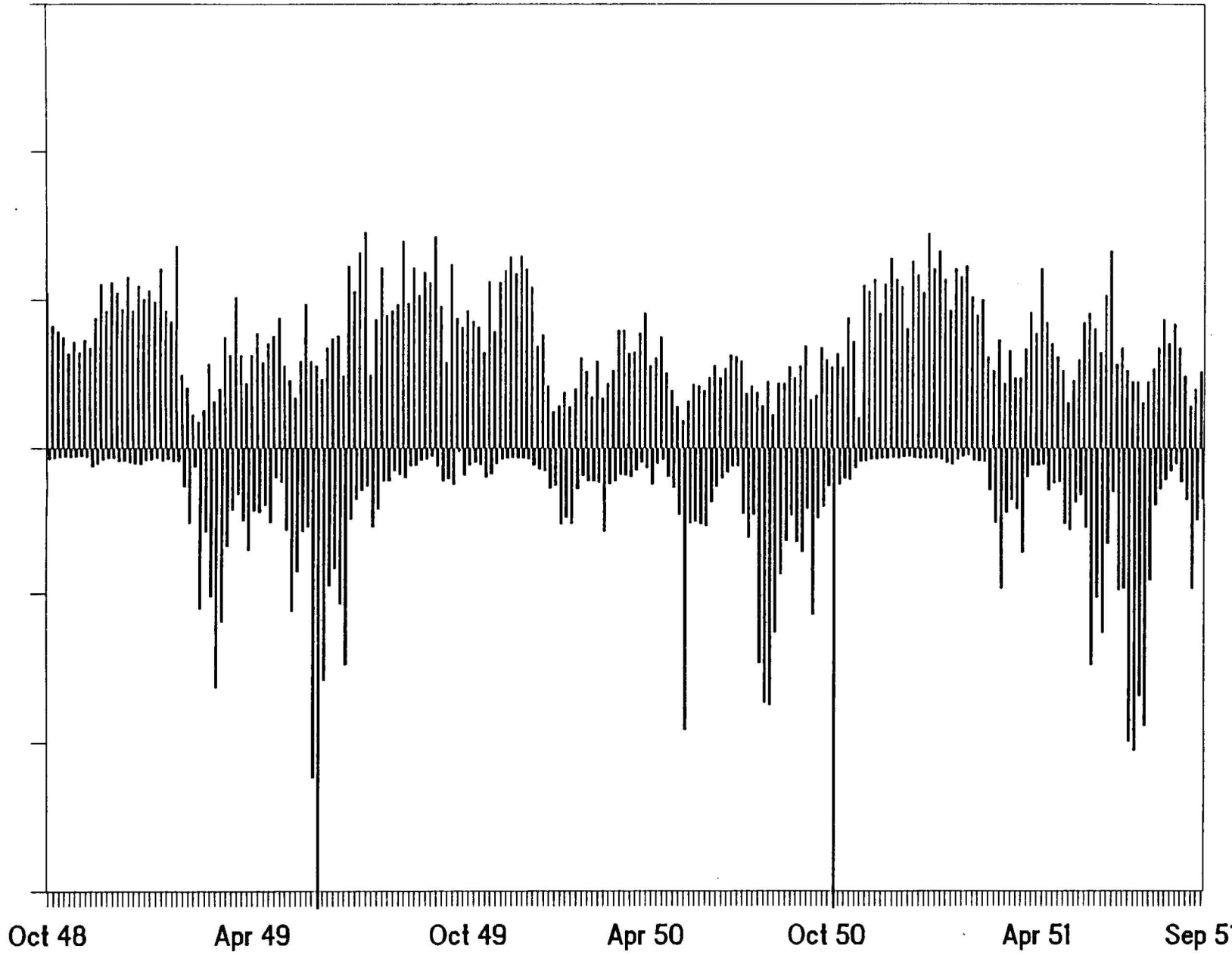

Figure 85. Graph of Sulfate And Flow Versus Time For The Van Buren Site 1948-1951.

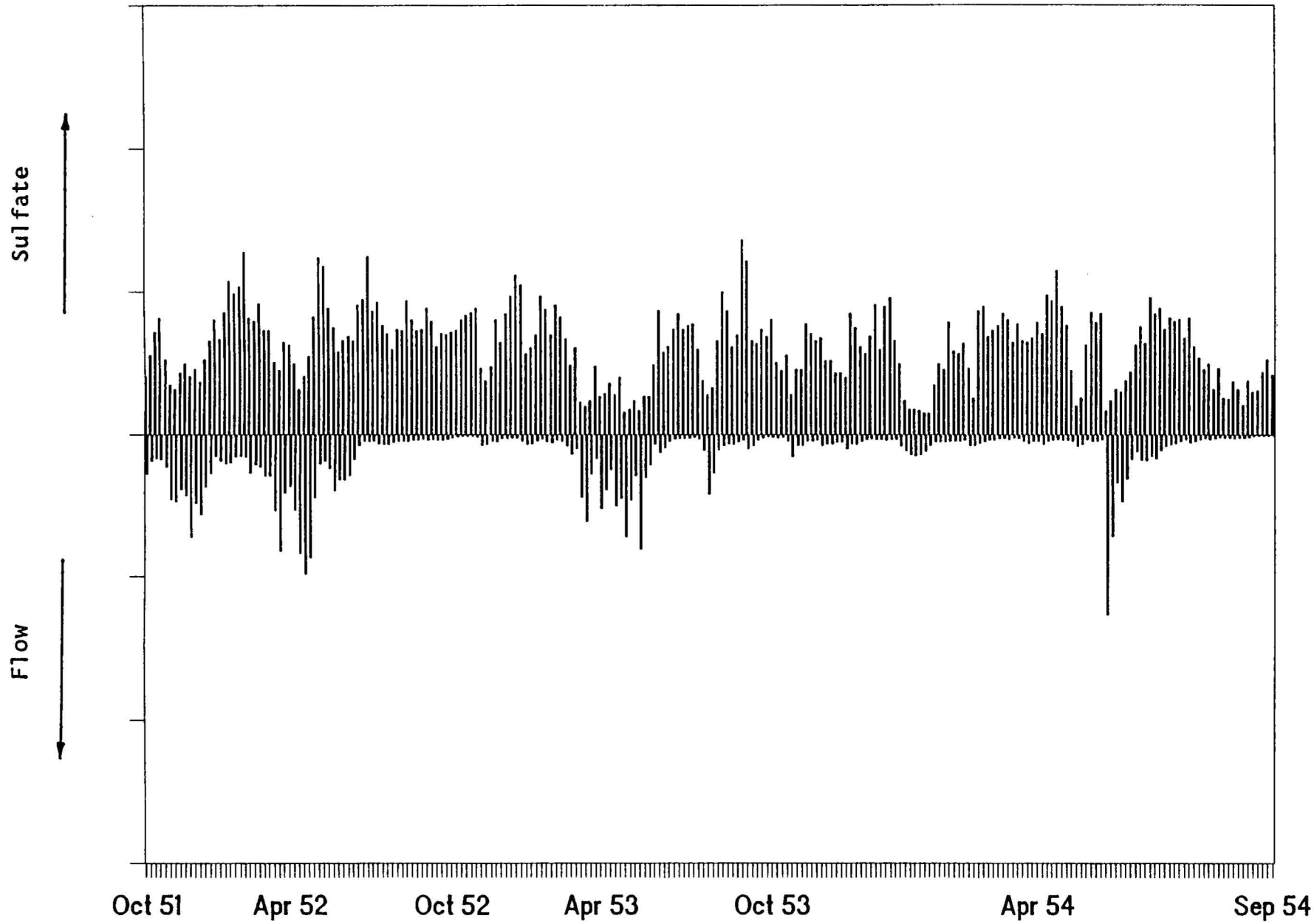

Figure 86. Graph of Sulfate And Flow Versus Time For The Van Buren Site 1951-1954.

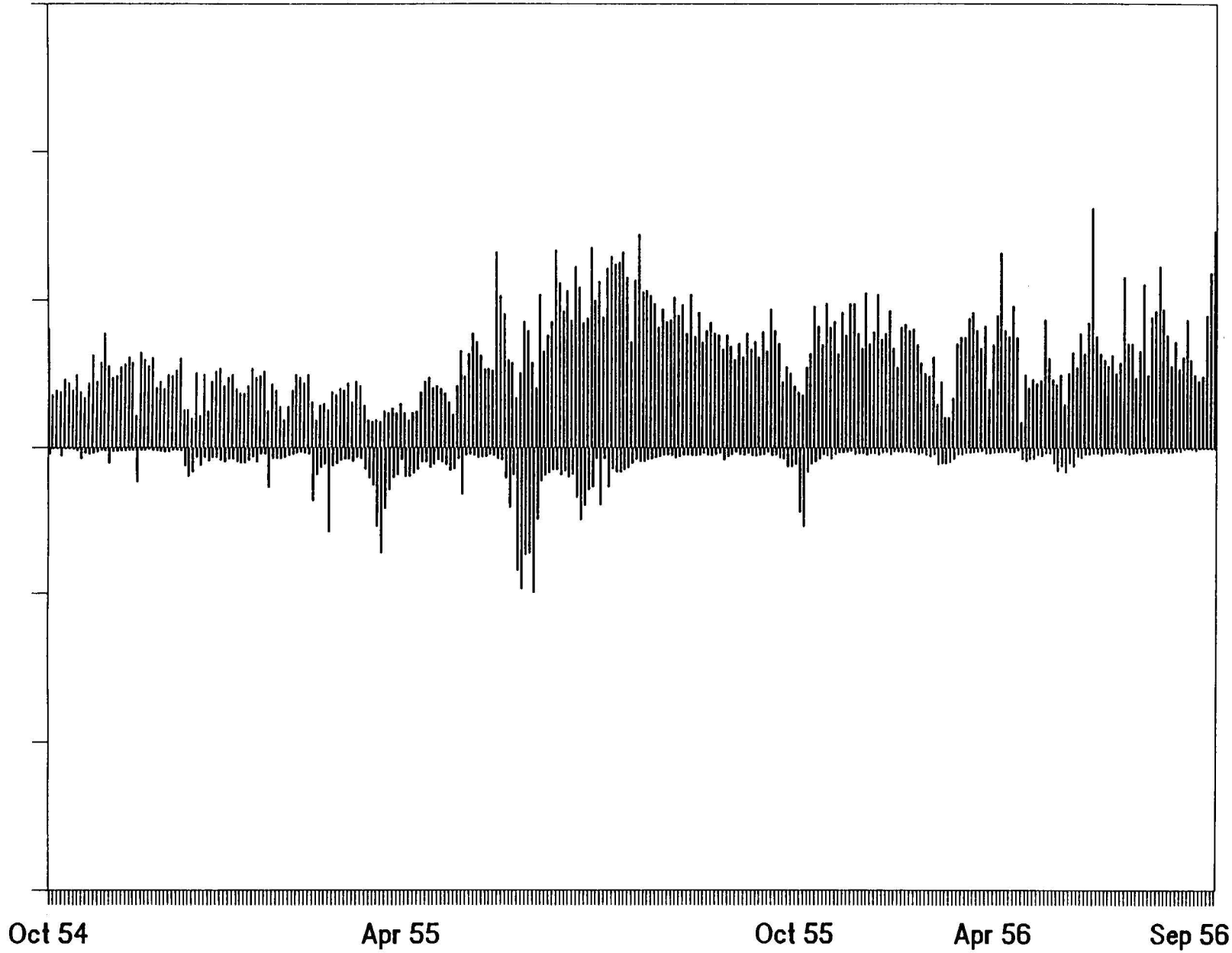

Figure 87. Graph of Sulfate And Flow Versus Time For The Van Buren Site 1954-1956.

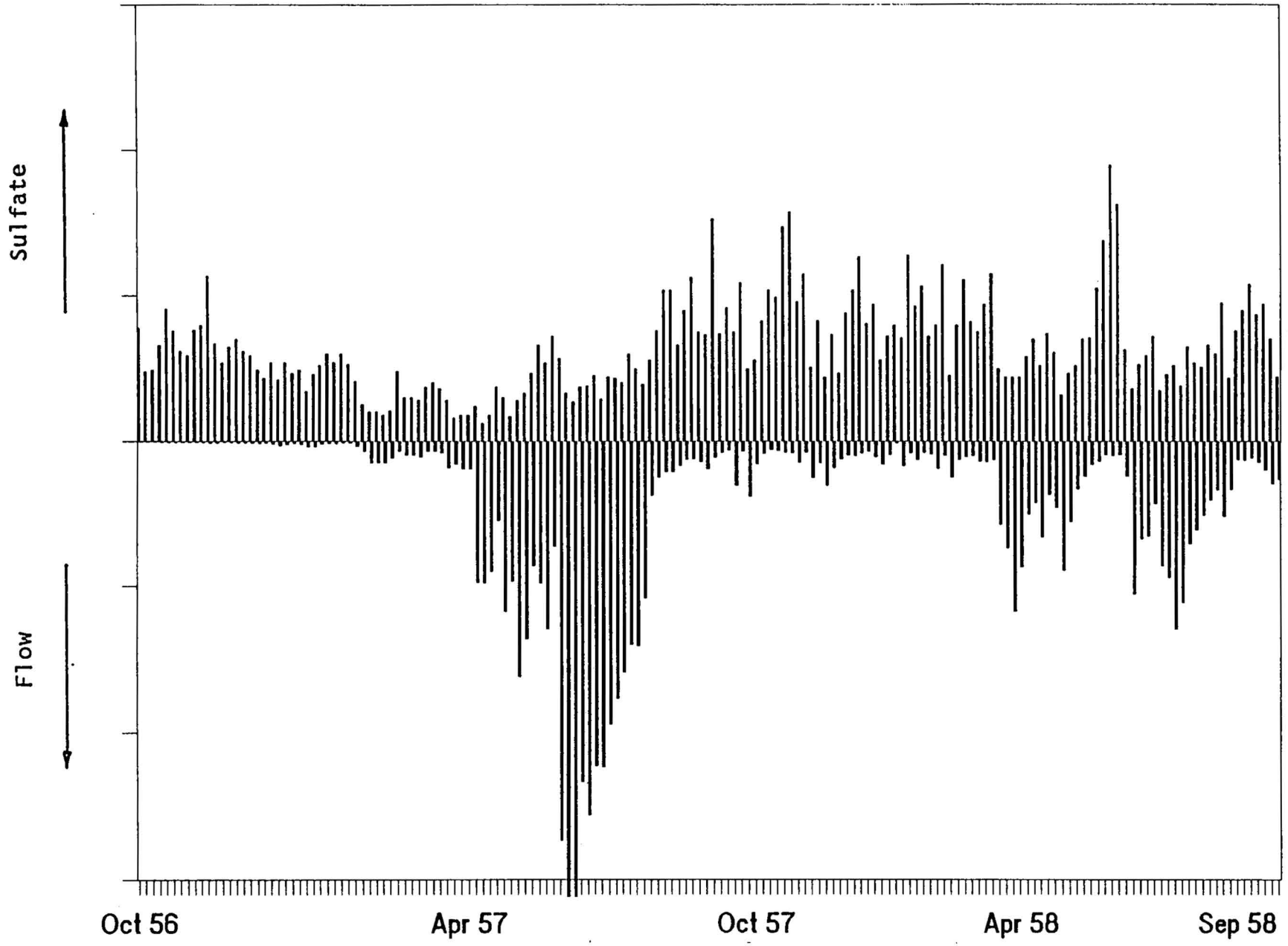

Figure 88. Graph of Sulfate And Flow Versus Time For The Van Buren Site 1956-1958.

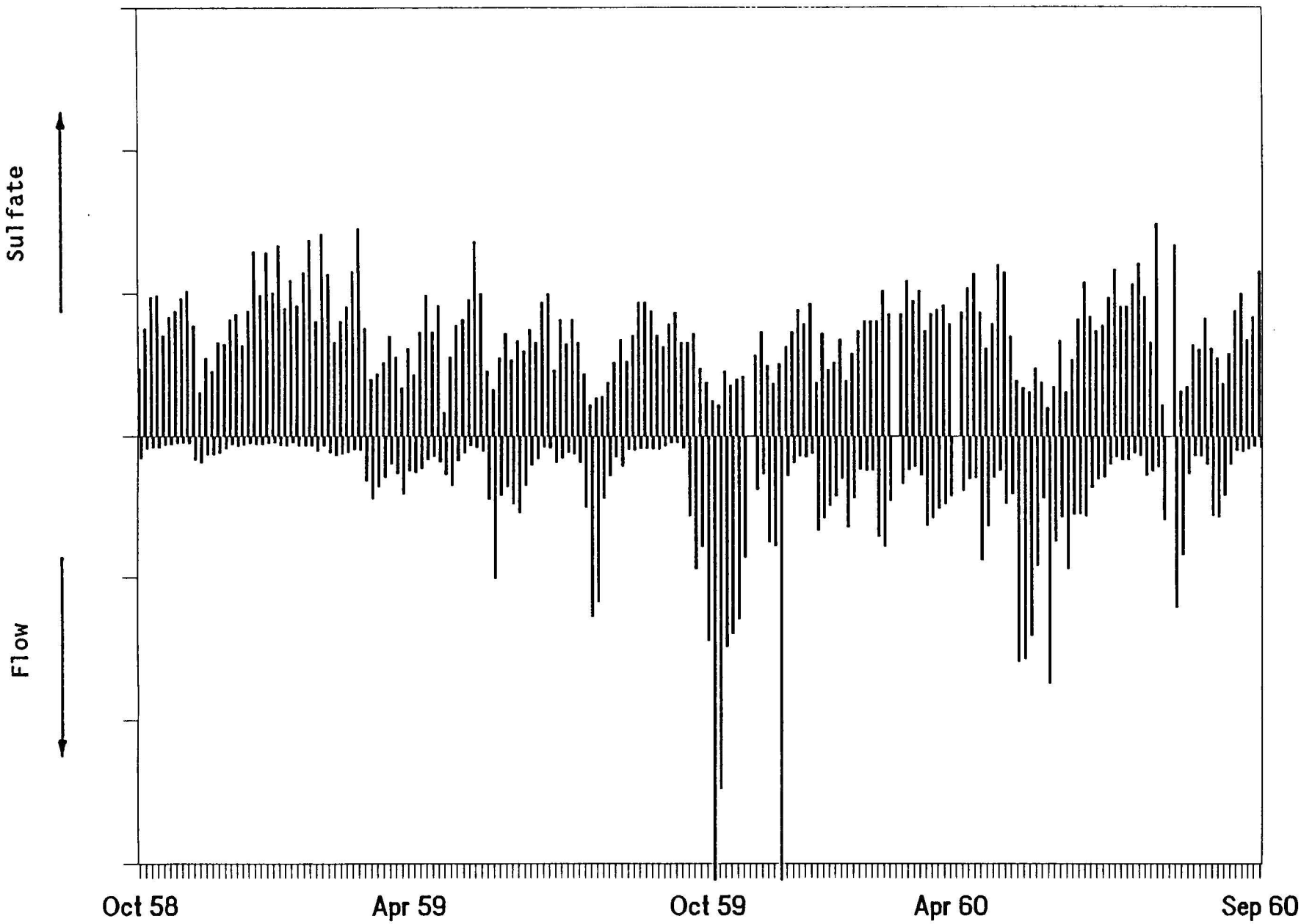

Figure 89. Graph of Sulfate And Flow Versus Time For The Van Buren Site 1958-1960.

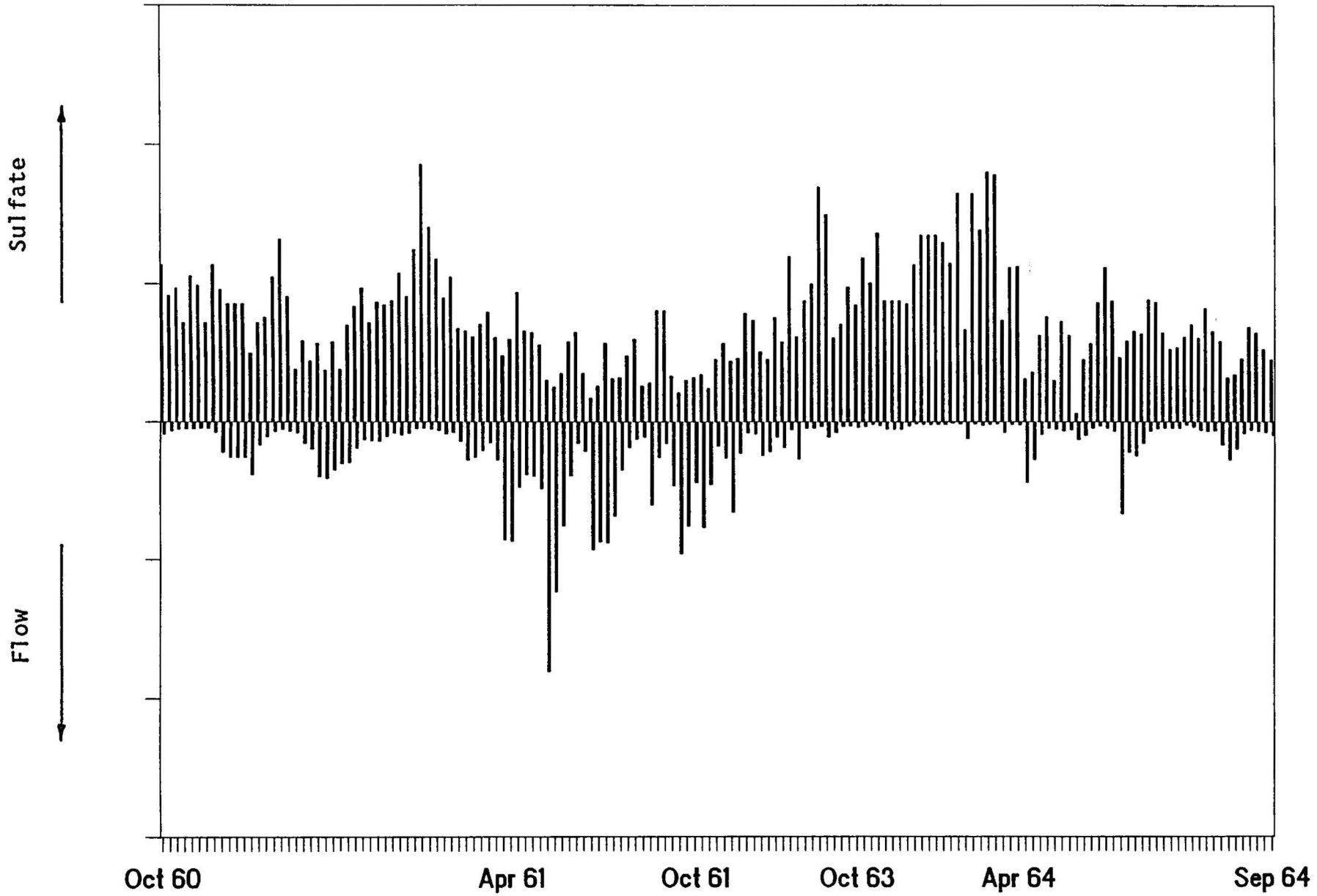

Figure 90. Graph of Sulfate And Flow Versus Time For The Van Buren Site 1960-1964.

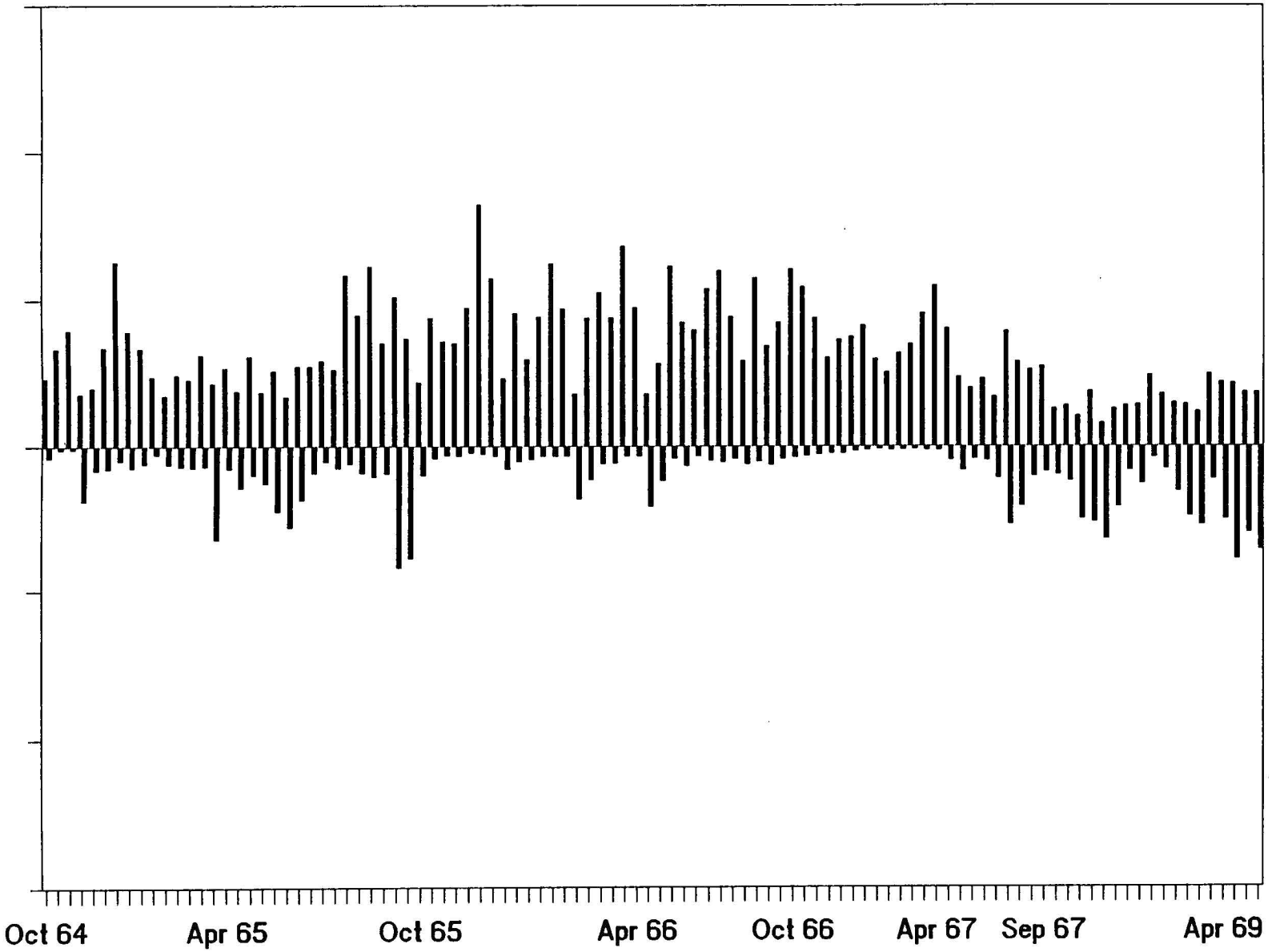

Figure 91. Graph of Sulfate And Flow Versus Time For The Van Buren Site 1964-1969.

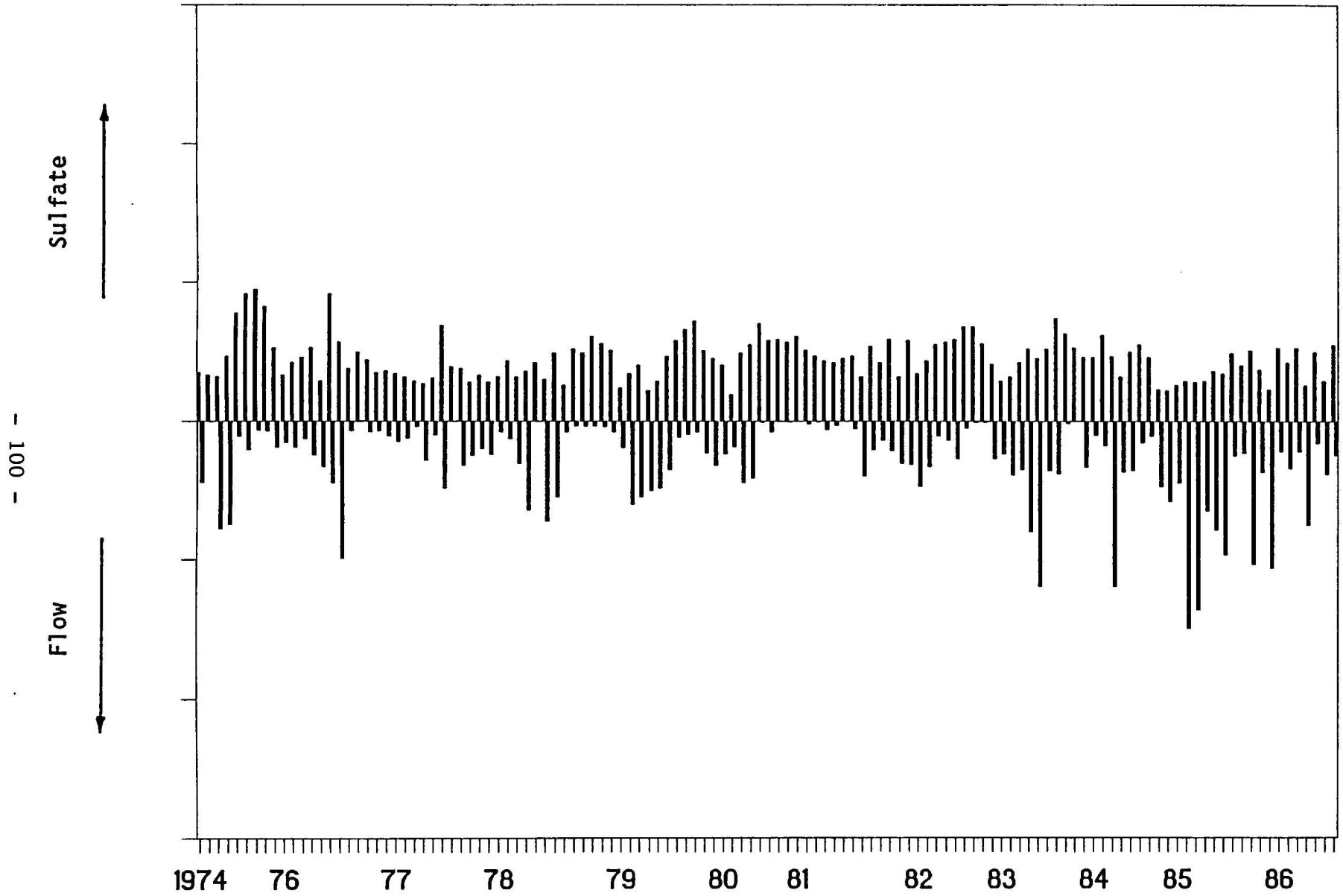

Figure 92. Graph of Sulfate And Flow Versus Time For The Van Buren Site 1974-1986.

1986 and 1945 through 1969 time periods. The average for the 1974-86 time period represents a significant decrease in the total hardness concentrations compared with the earlier period. The average total hardness during the 1974-86 time period was about 55 percent of the average concentration in the earlier period. Figures 93 through 100 show the total hardness concentrations plotted versus time from 1945 through 1969. Figures 101 and 102 show the total hardness concentrations for the time periods from 1945 through 1969 and from 1975 through 1986, respectively. Figures 103 through 111 provide a comparison of flow and total hardness plotted as a function of time. As shown by these figures, there was a much more apparent tendency for larger total hardness concentrations at lower flow rates during the 1945 to 1969 time period than for the 1974 through 1986 time period.

Turbidity. Figure 112 shows the limited turbidity data available for the Van Buren site. The average turbidity was 46 turbidity units with the range from 4.5 to 220 units. Both turbidity and flow are plotted versus time in Figure 113.

Van Buren (Lock and Dam No. 13)

The location for this sampling site is at the control house for lock and dam number 13 on the right bank of the river. The site is at mile 308.9.

Alkalinity. The average alkalinity concentration for the period of record from July, 1969 until July, 1987 was 92 mg/L. The concentrations ranged from 16 to 151 mg/L. One

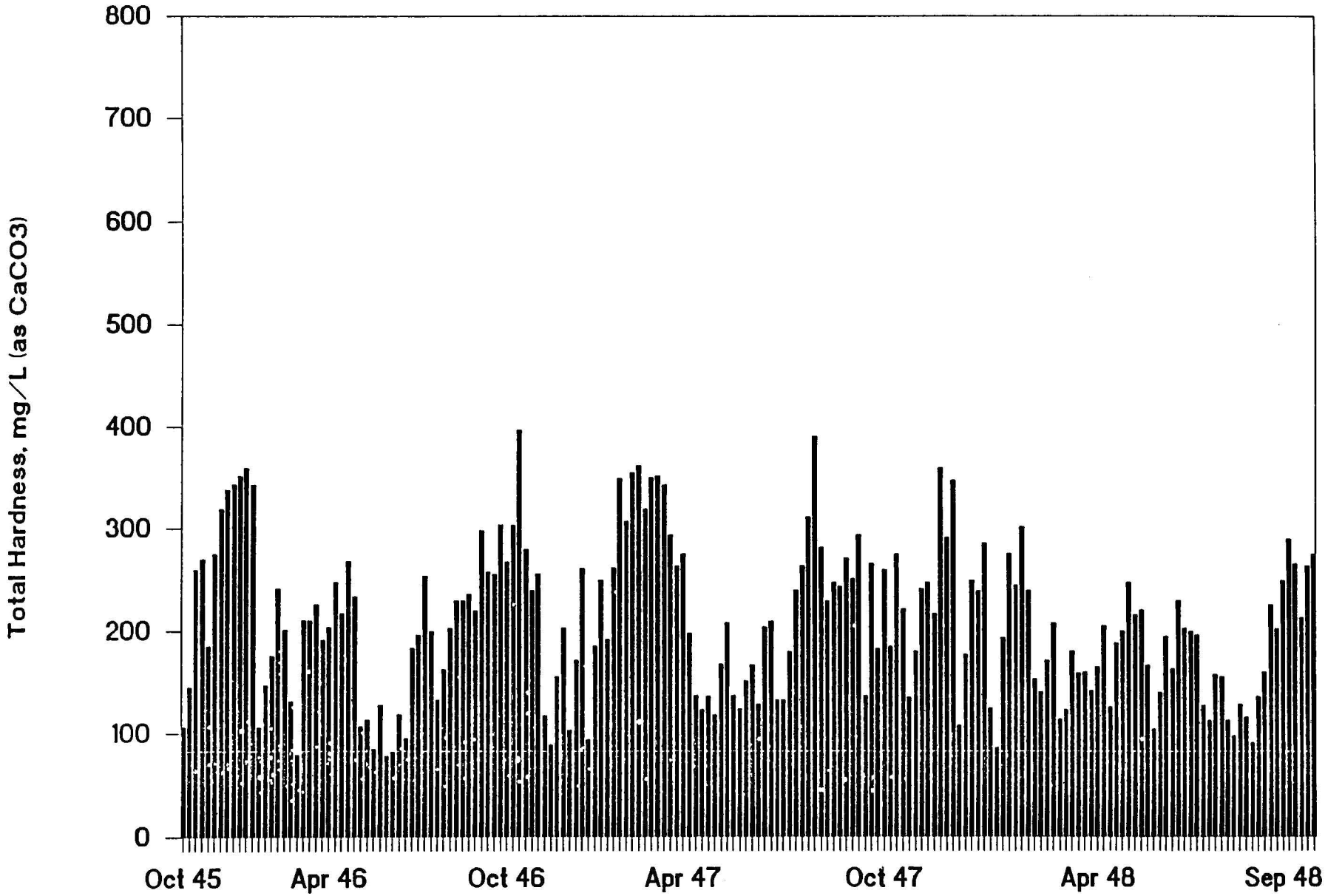

Figure 93. Graph of Total Hardness Versus Time For The Van Buren Site 1945-1948.

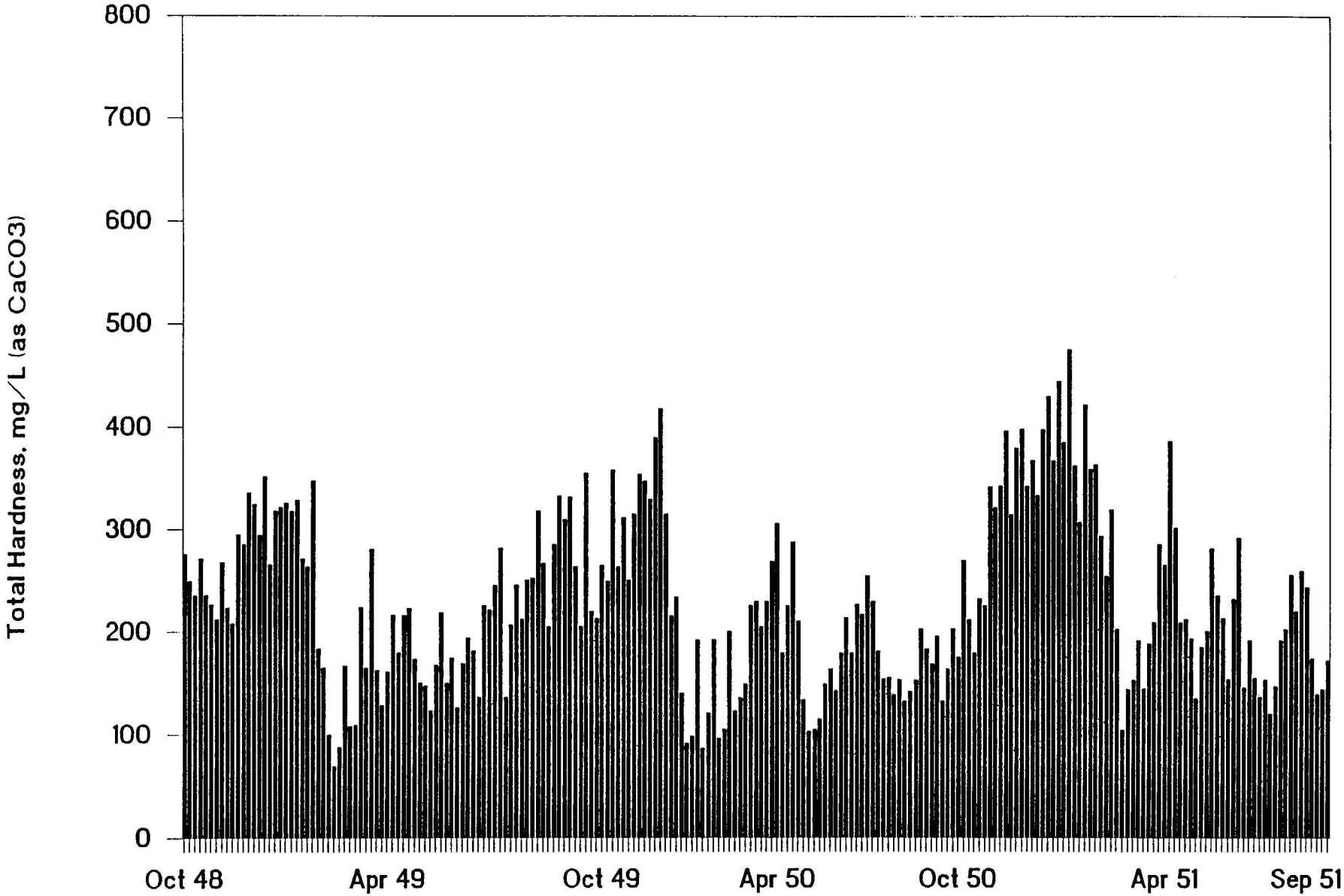

Figure 94. Graph of Total Hardness Versus Time For The Van Buren Site 1948-1951.

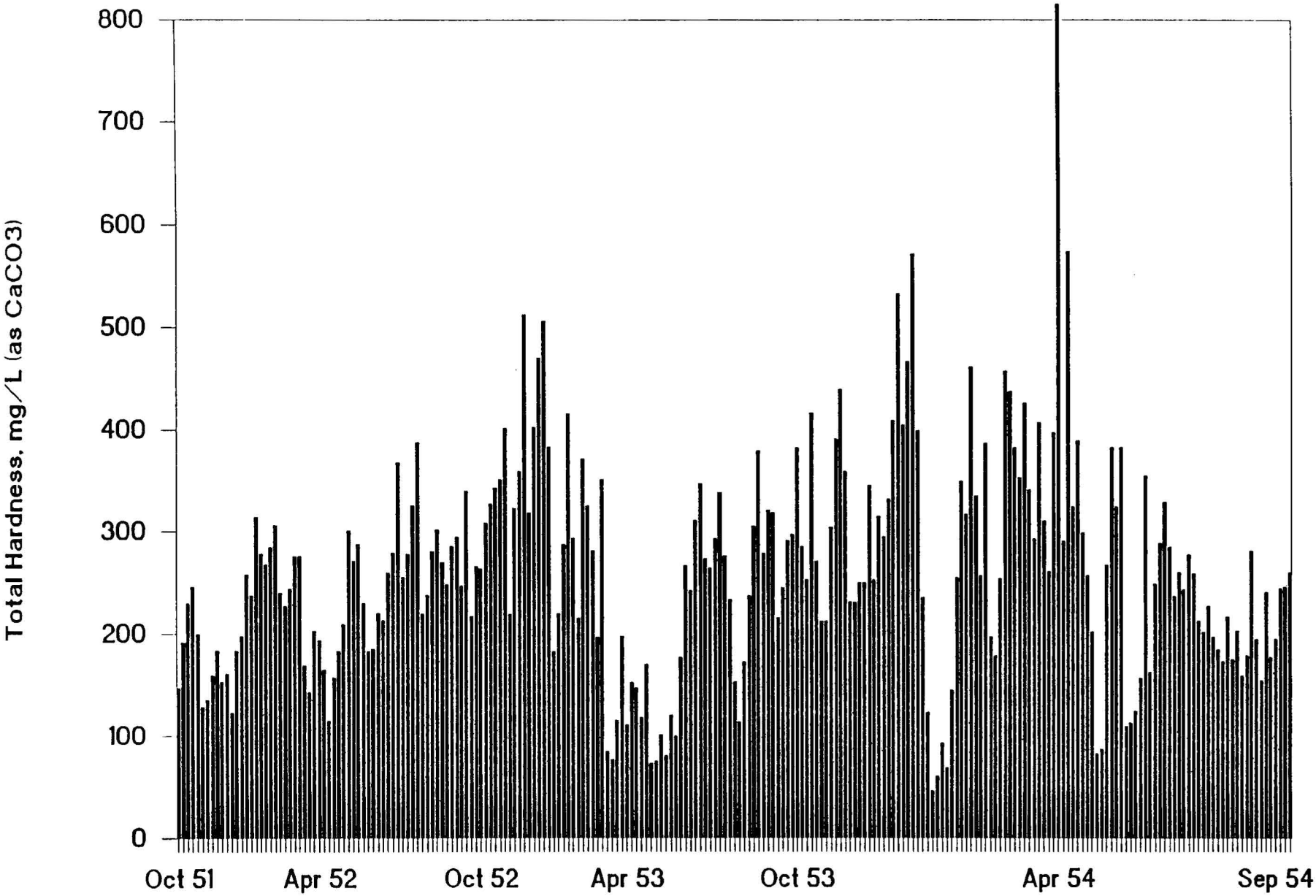

Figure 95. Graph of Total Hardness Versus Time For The Van Buren Site 1951-1954.

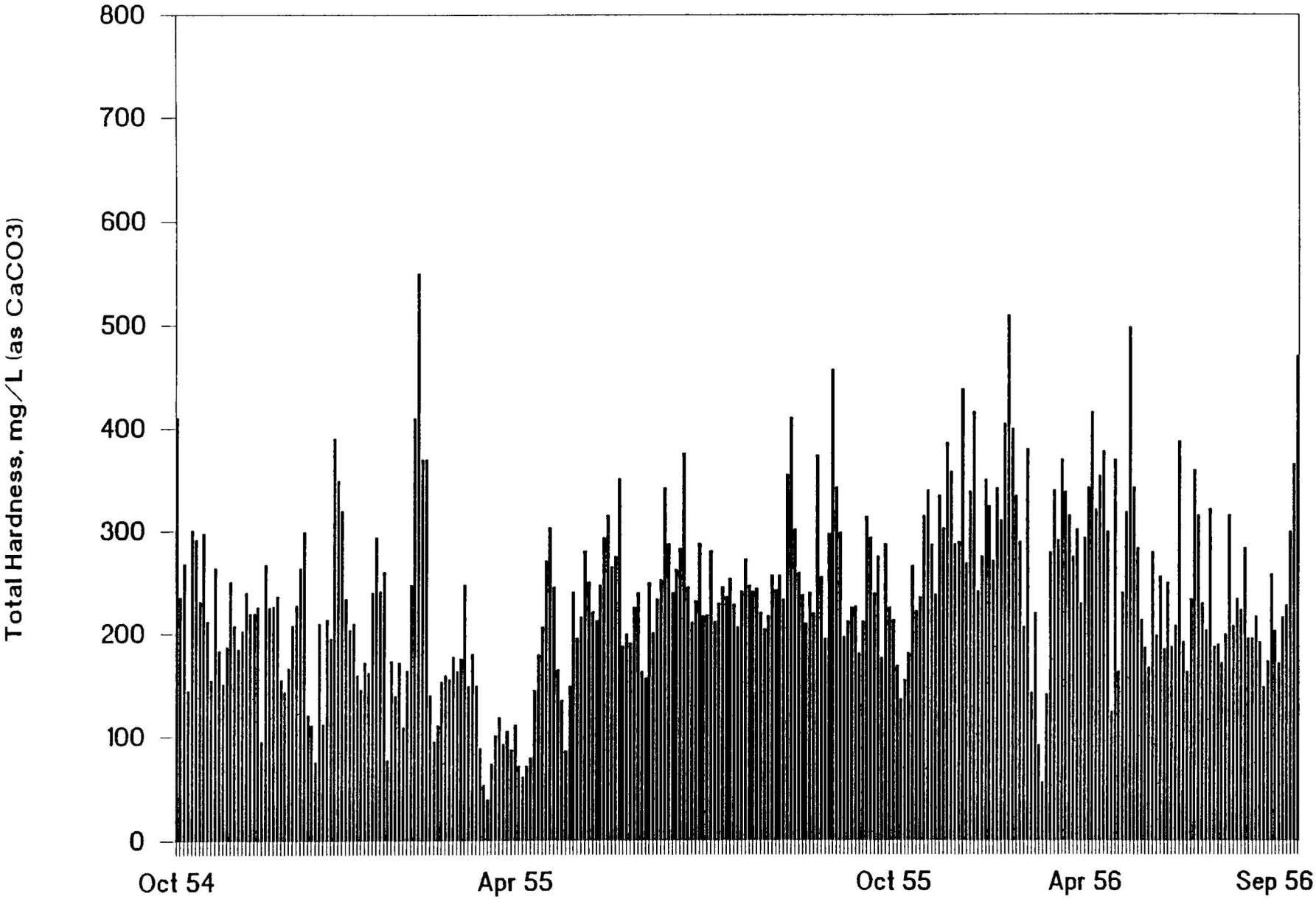

Figure 96. Graph of Total Hardness Versus Time For The Van Buren Site 1954-1956.

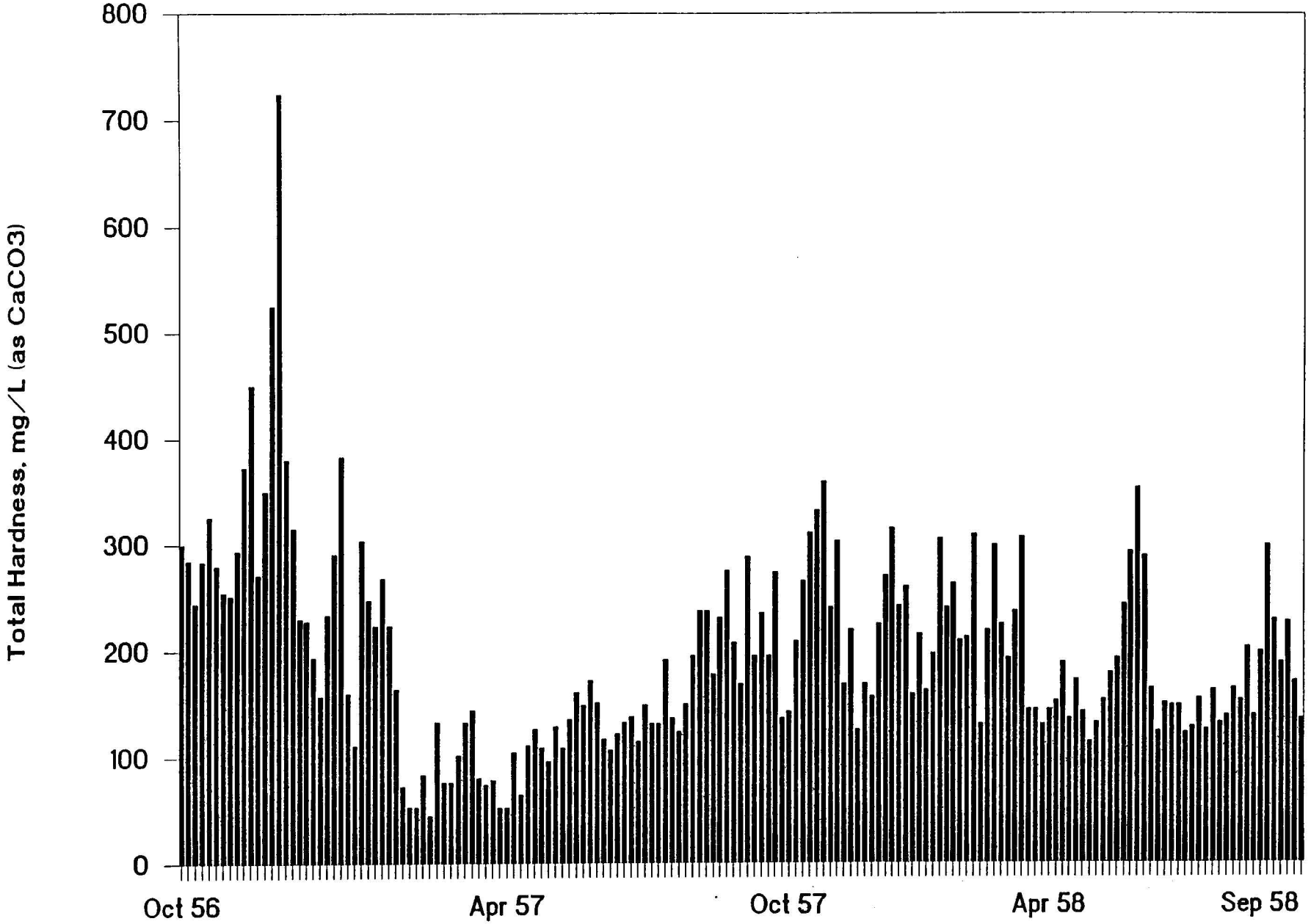

Figure 97. Graph of Total Hardness Versus Time For The Van Buren Site 1956-1958.

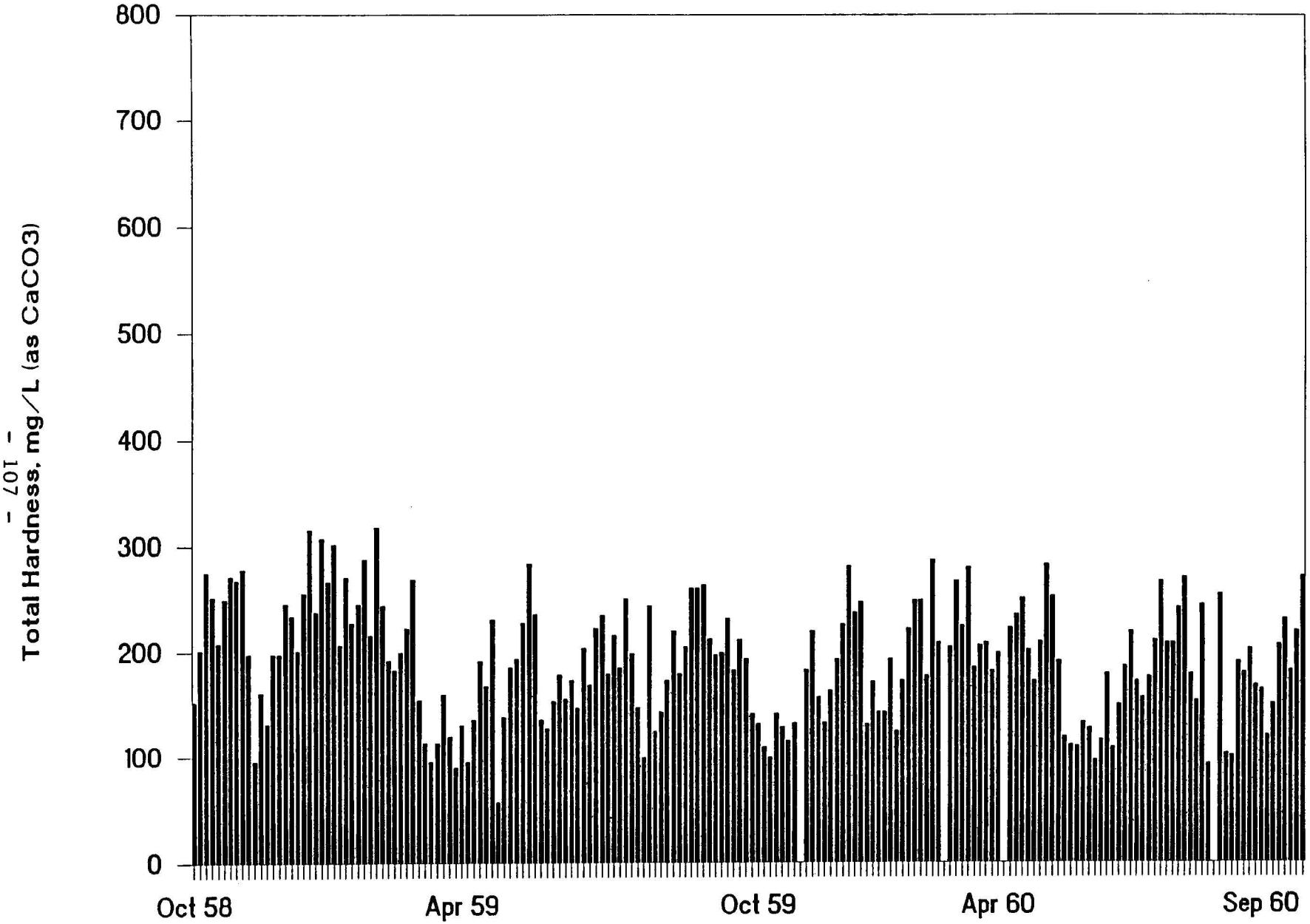

Figure 98. Graph of Total Hardness Versus Time For The Van Buren Site 1958-1960.

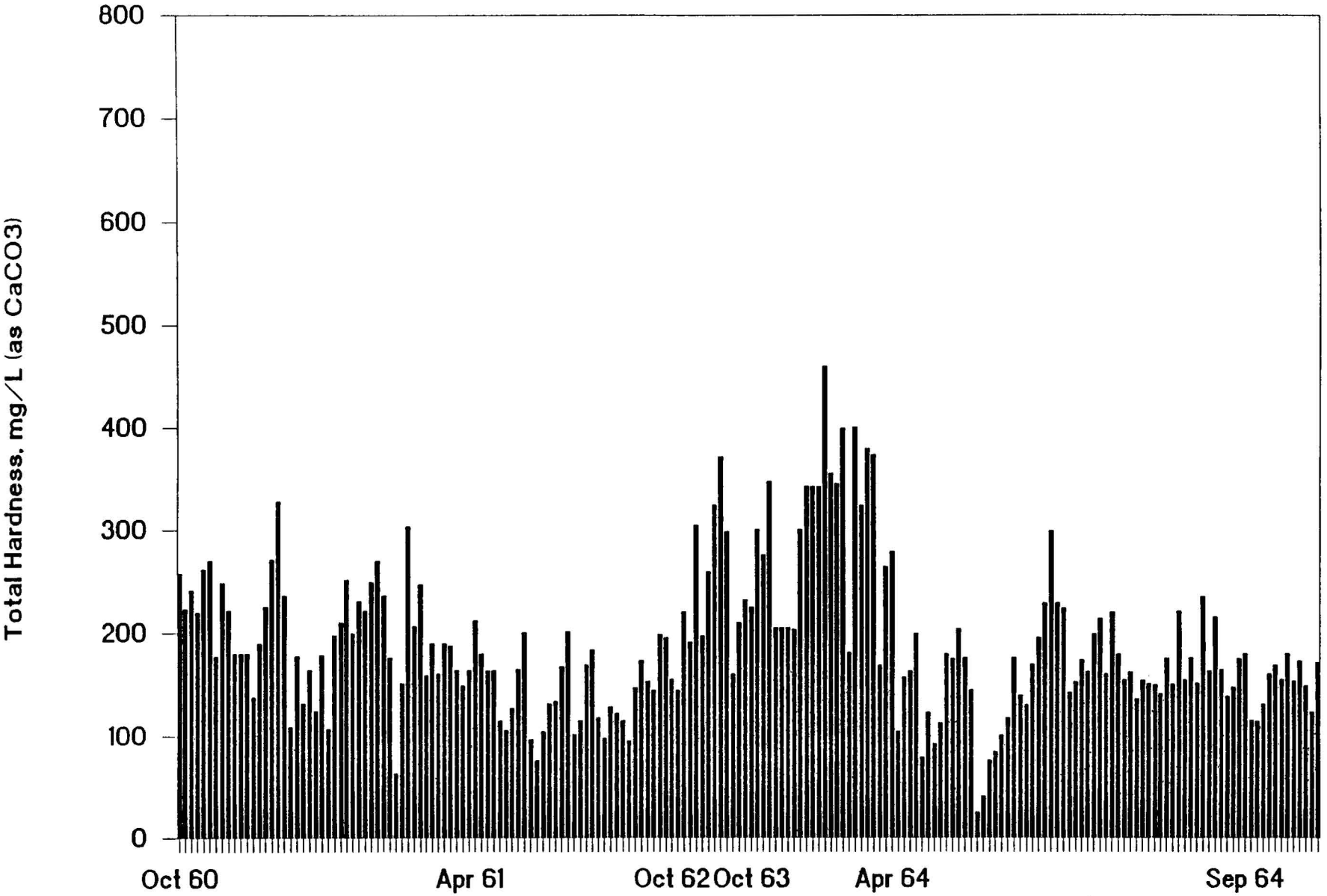

Figure 99. Graph of Total Hardness Versus Time For The Van Buren Site 1960-1964.

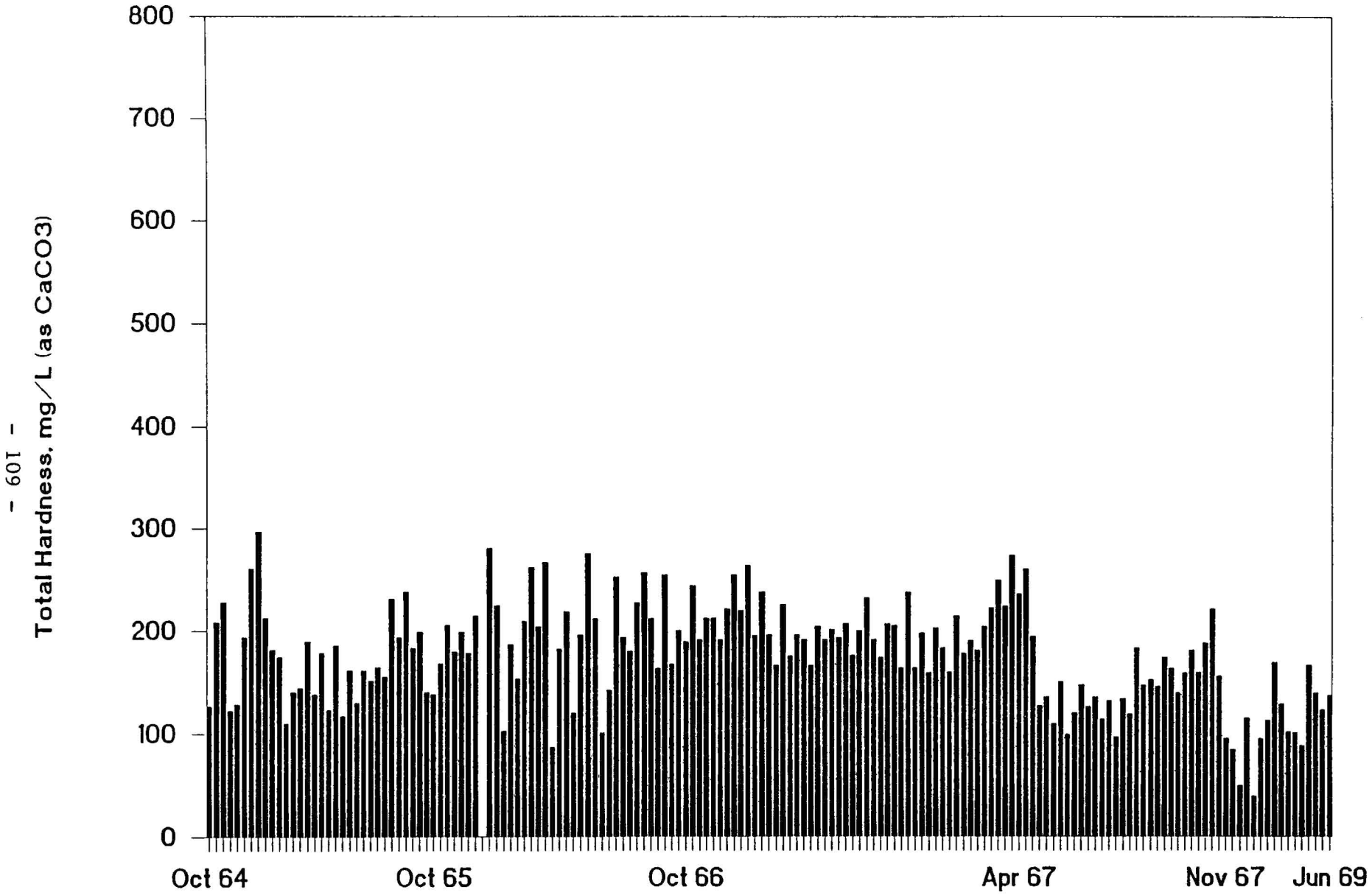

Figure 100. Graph of Total Hardness Versus Time For The Van Buren Site 1964-1969.

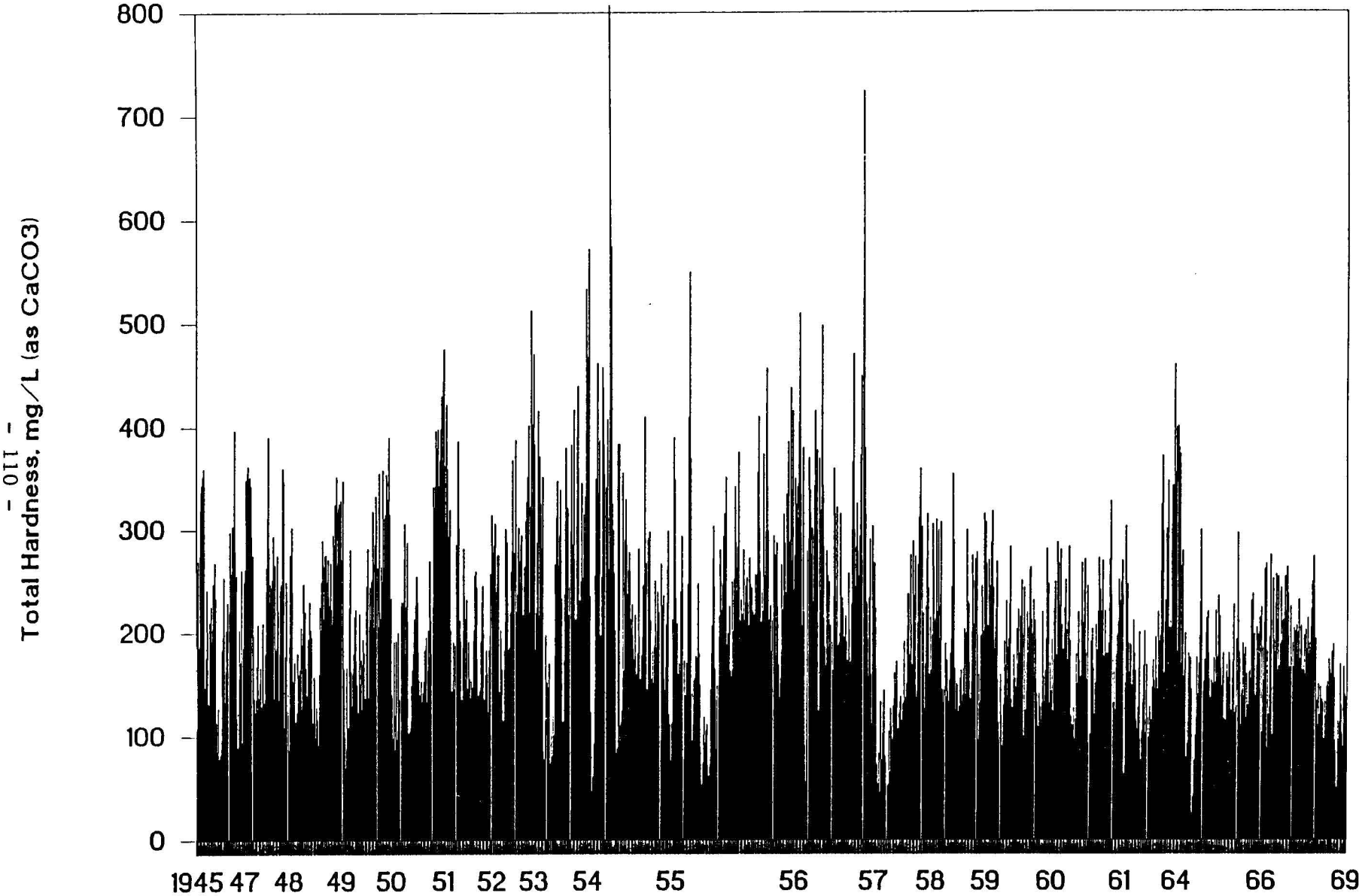

Figure 101. Graph of Total Hardness Versus Time For The Van Buren Site 1945-1969.

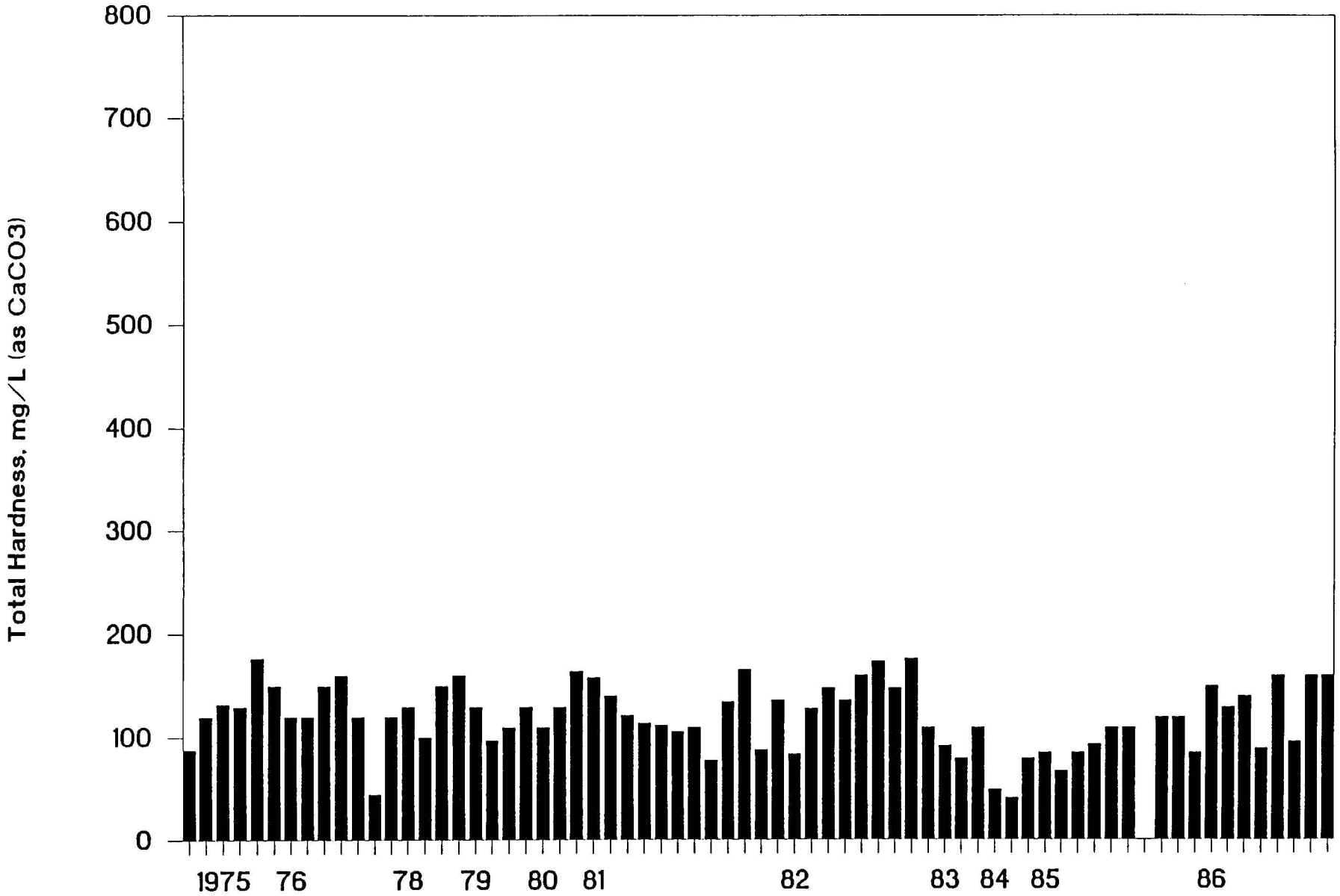

Figure 102. Graph of Total Hardness Versus Time For The Van Buren Site 1975-1986.

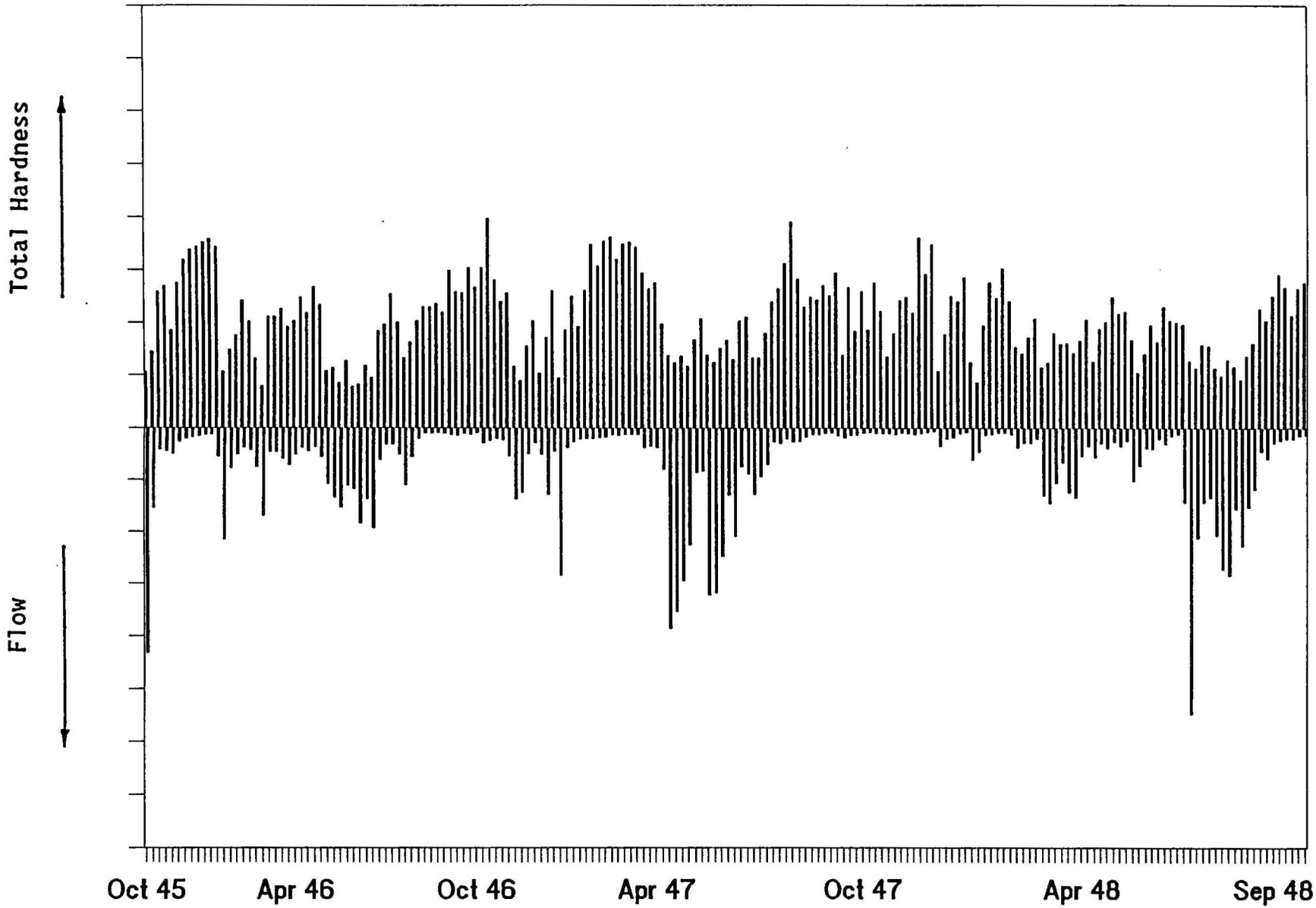

Figure 103. Graph of Total Hardness And Flow Versus Time For The Van Buren Site 1945-1948.

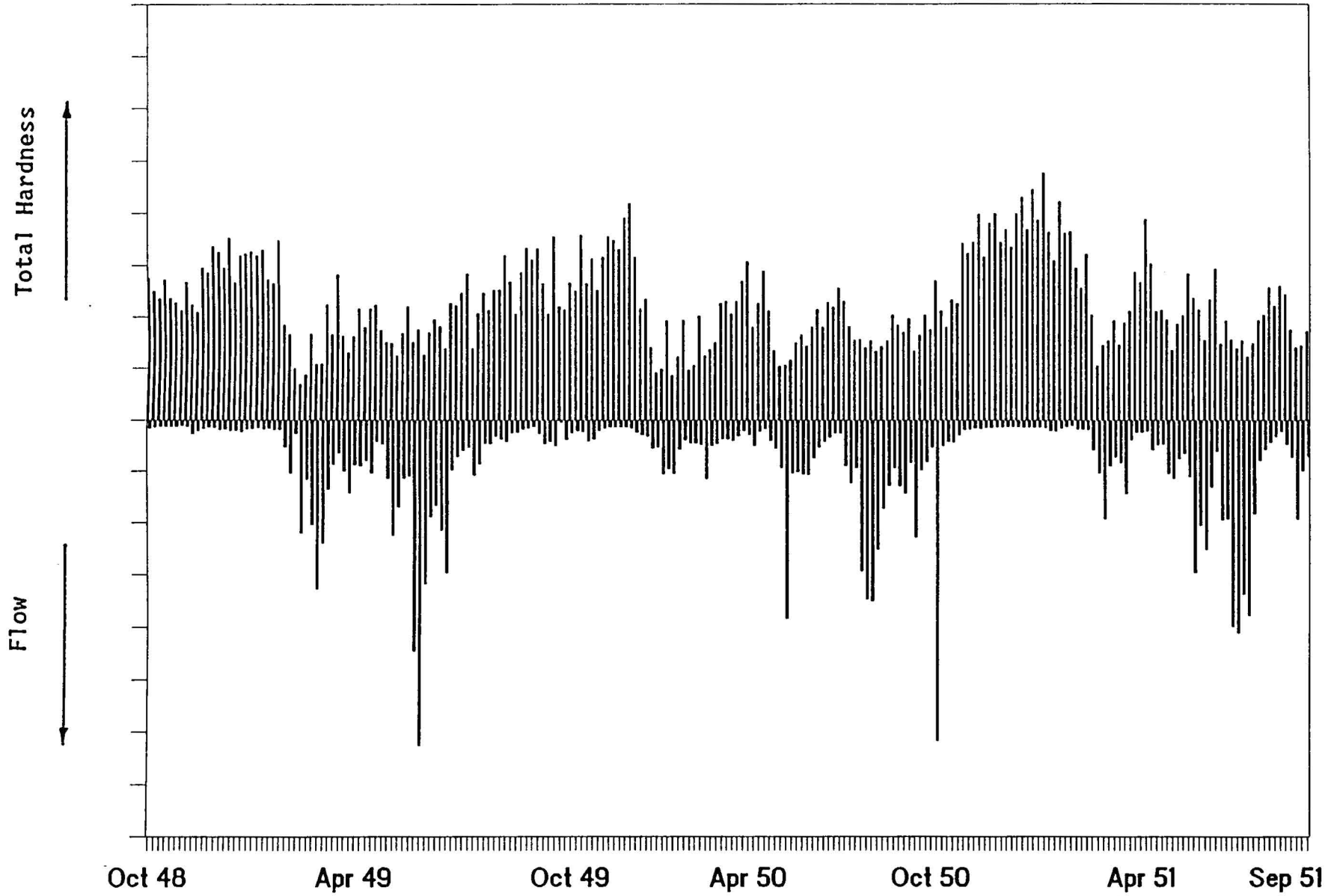

Figure 104. Graph of Total Hardness And Flow Versus Time For The Van Buren Site 1948-1951.

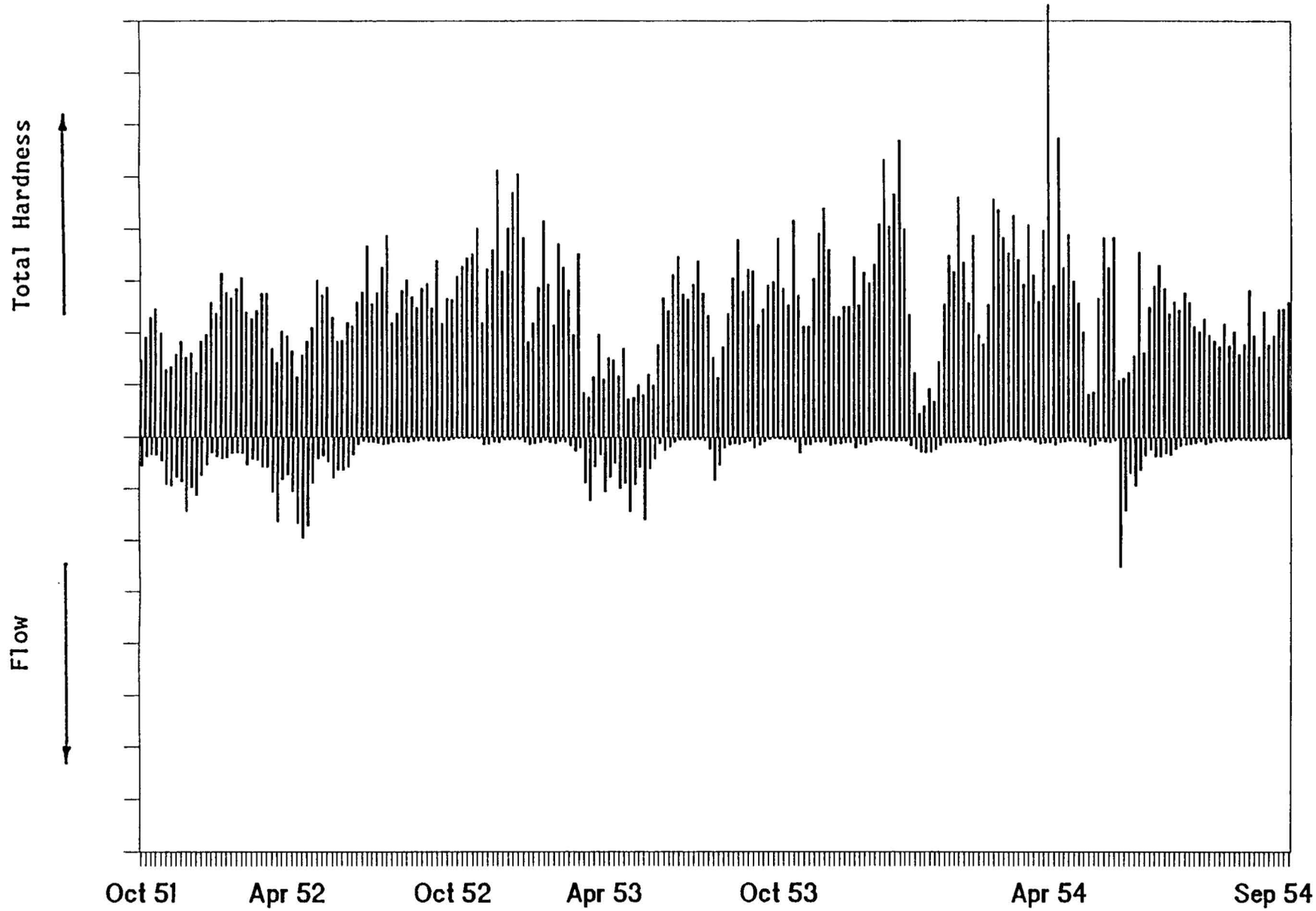

Figure 105. Graph of Total Hardness And Flow Versus Time For The Van Buren Site 1951-1954.

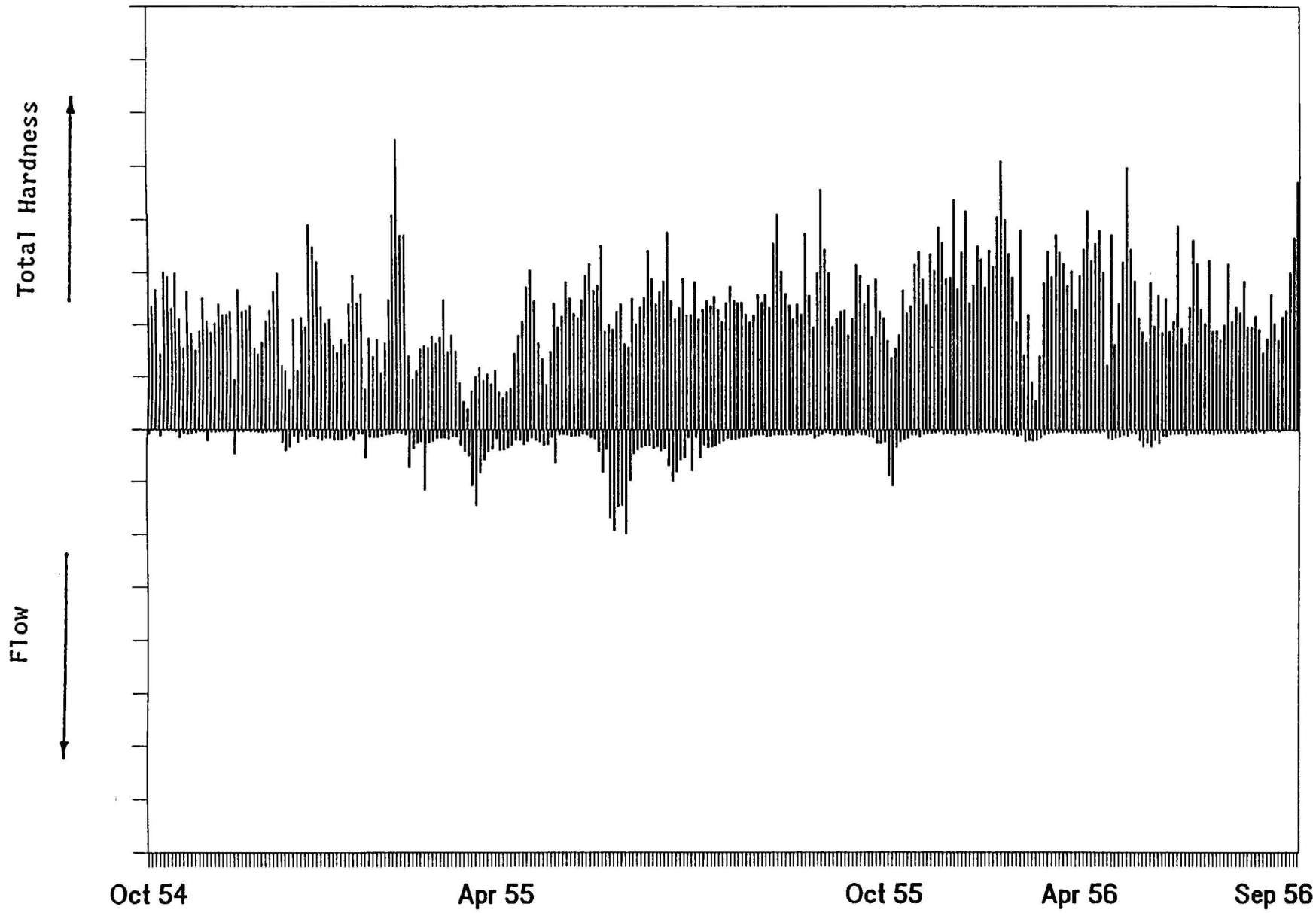

Figure 106. Graph of Total Hardness And Flow Versus Time For The Van Buren Site 1954-1956.

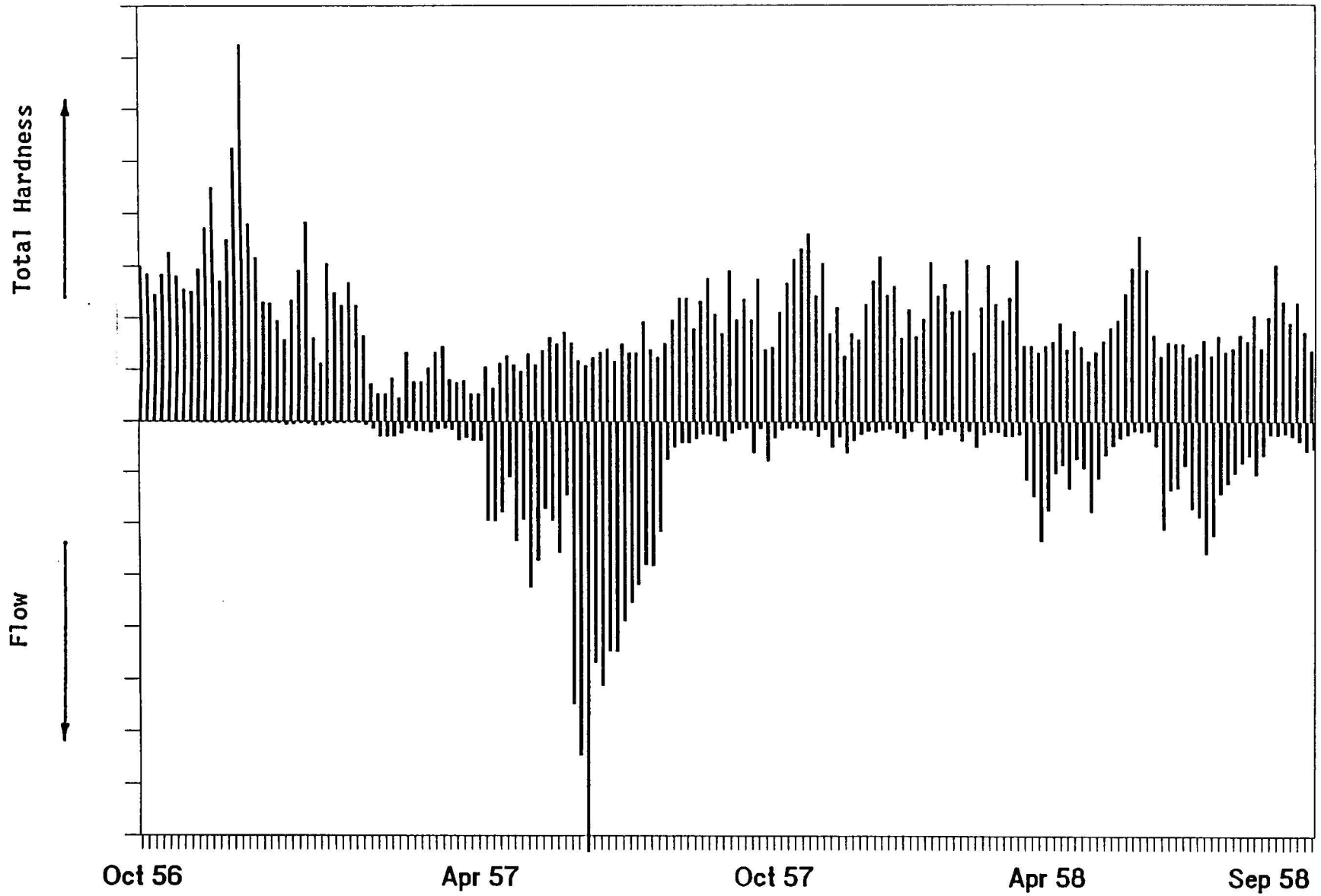

Figure 107. Graph of Total Hardness And Flow Versus Time For The Van Buren Site 1956-1958.

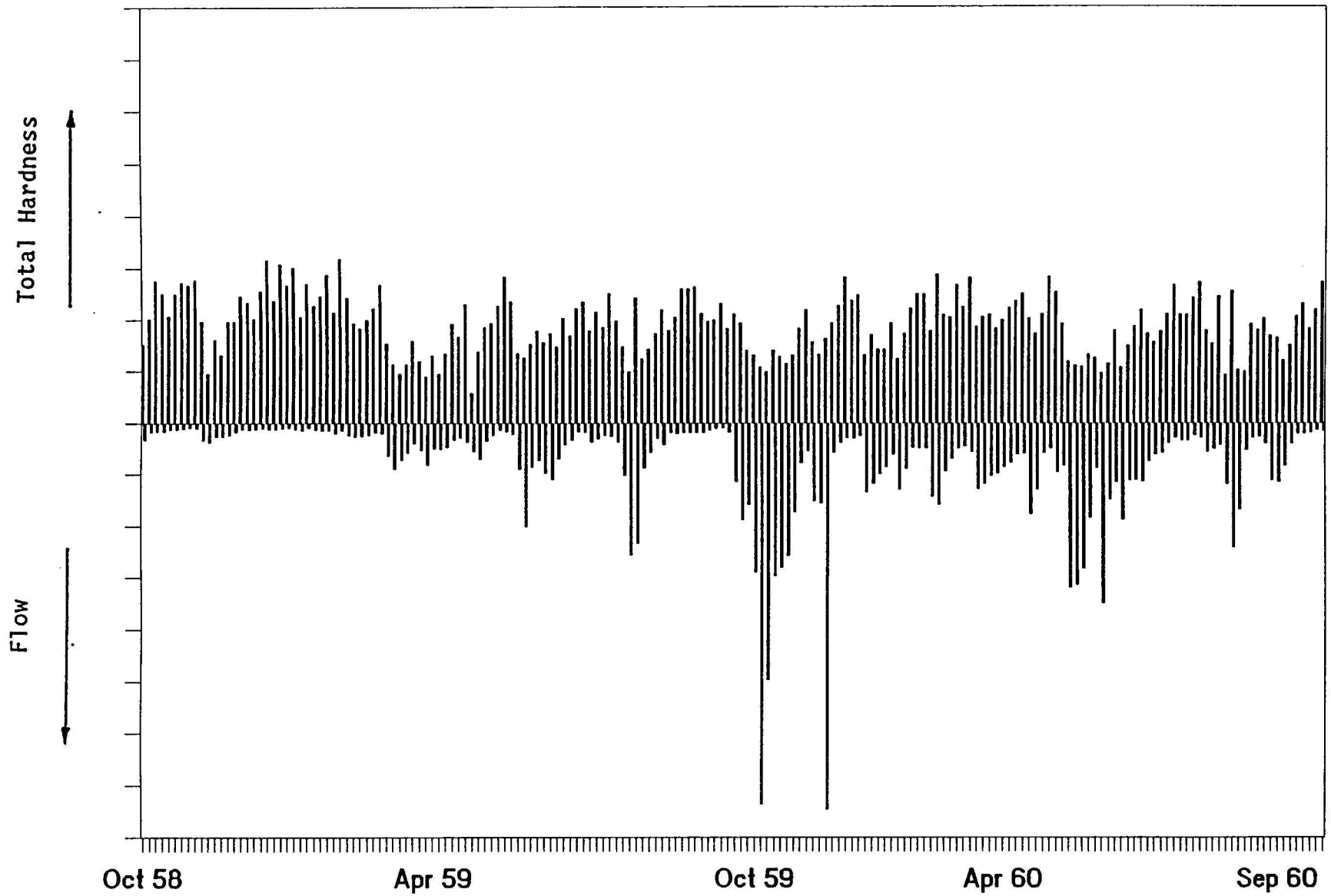

Figure 108. Graph of Total Hardness And Flow Versus Time For The Van Buren Site 1958-1960.

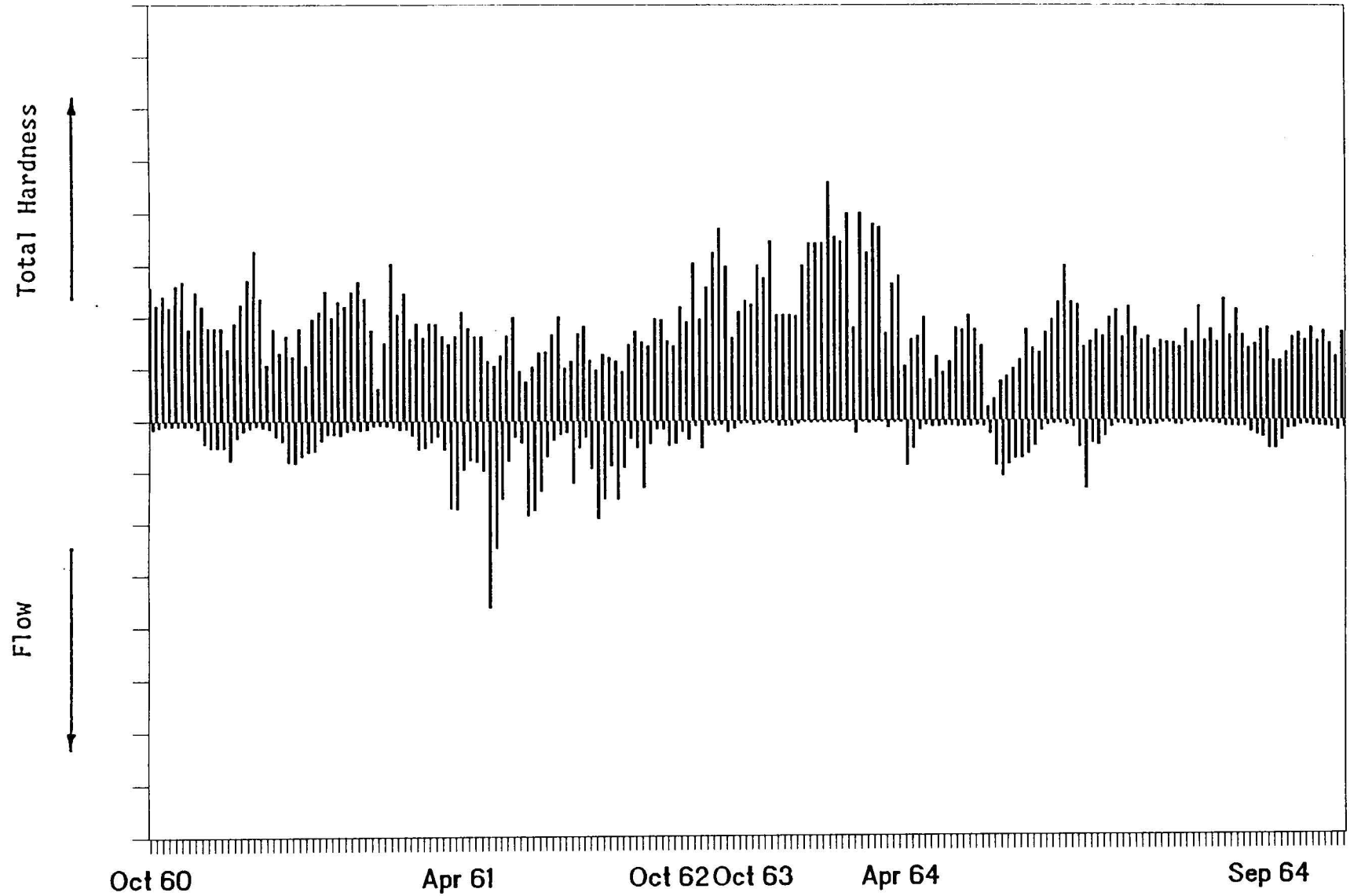

Figure 109. Graph of Total Hardness And Flow Versus Time For The Van Buren Site 1960-1964.

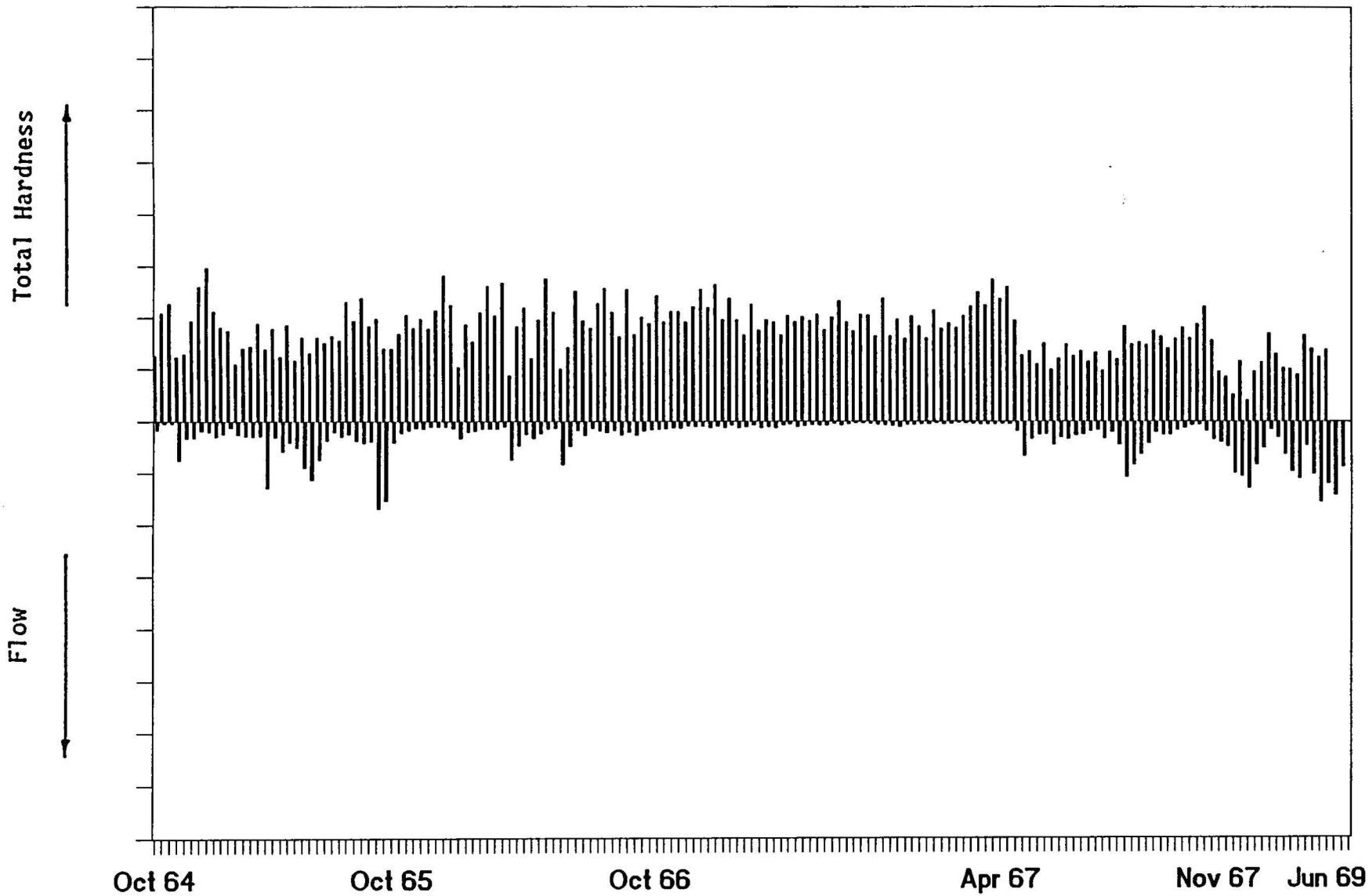

Figure 110. Graph of Total Hardness And Flow Versus Time For The Van Buren Site 1964-1969.

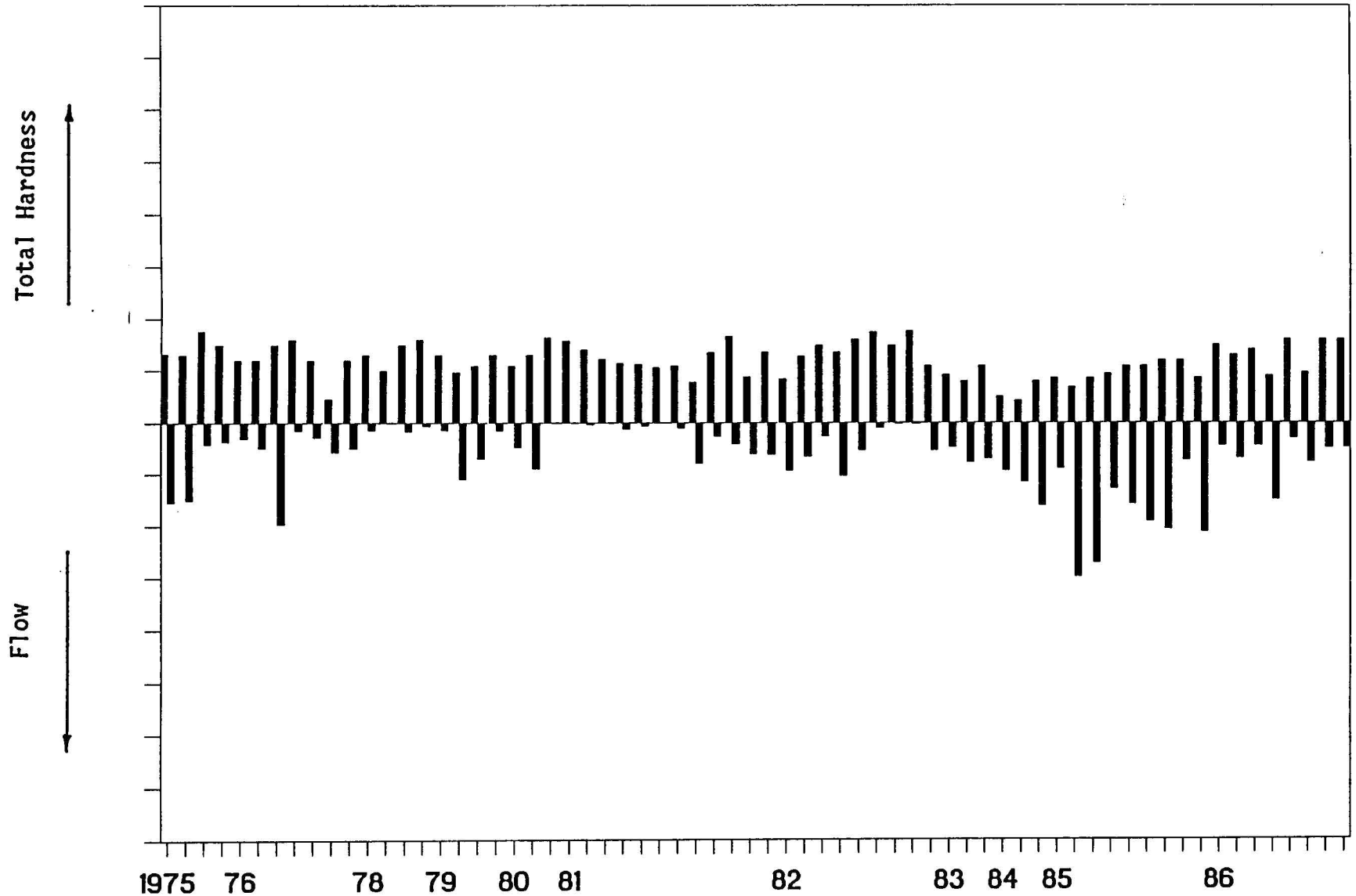

Figure 111. Graph of Total Hardness And Flow Versus Time For The Van Buren Site 1975-1986.

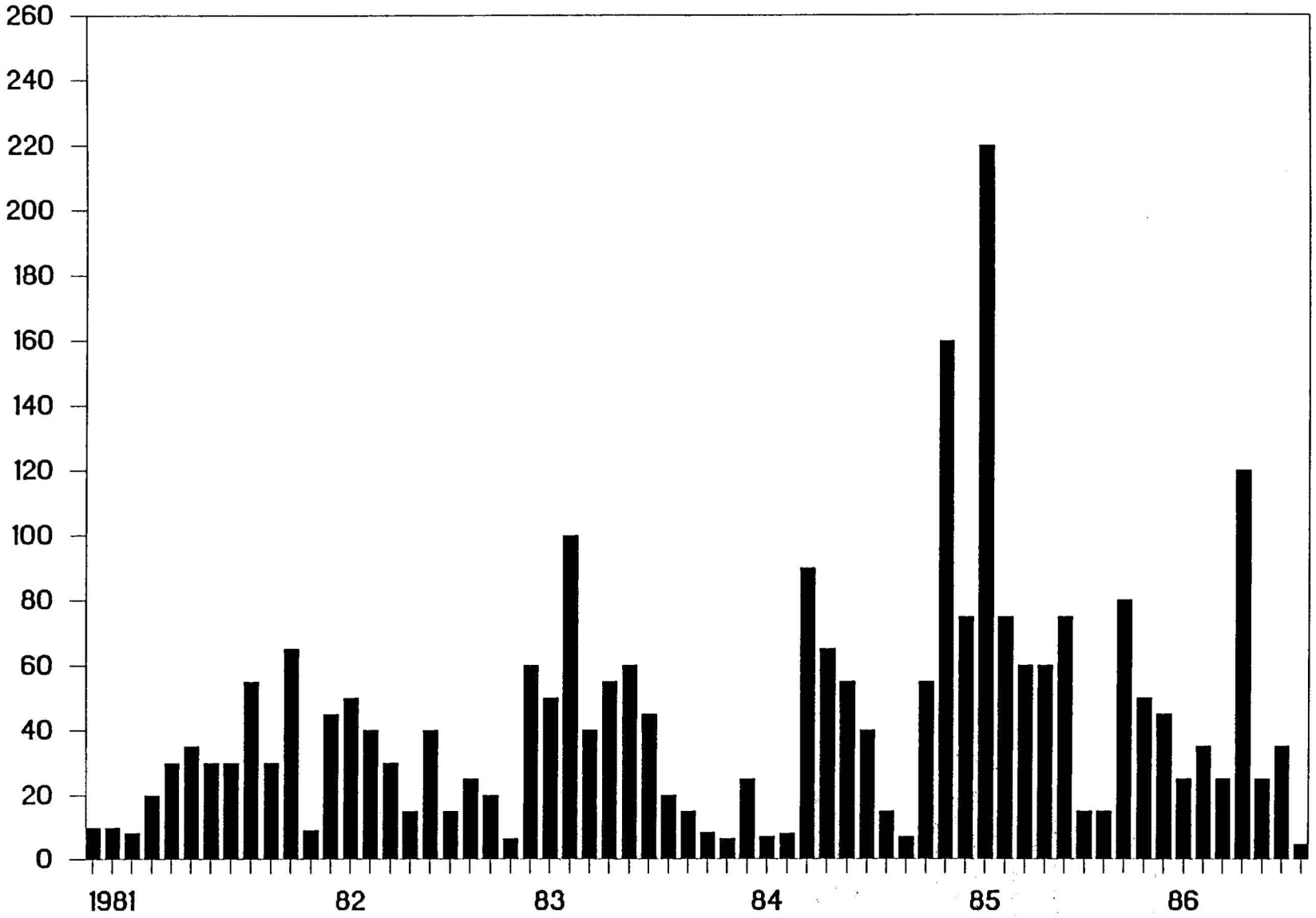

Figure 112. Graph of Turbidity Versus Time For The Van Buren Site 1981-1986.

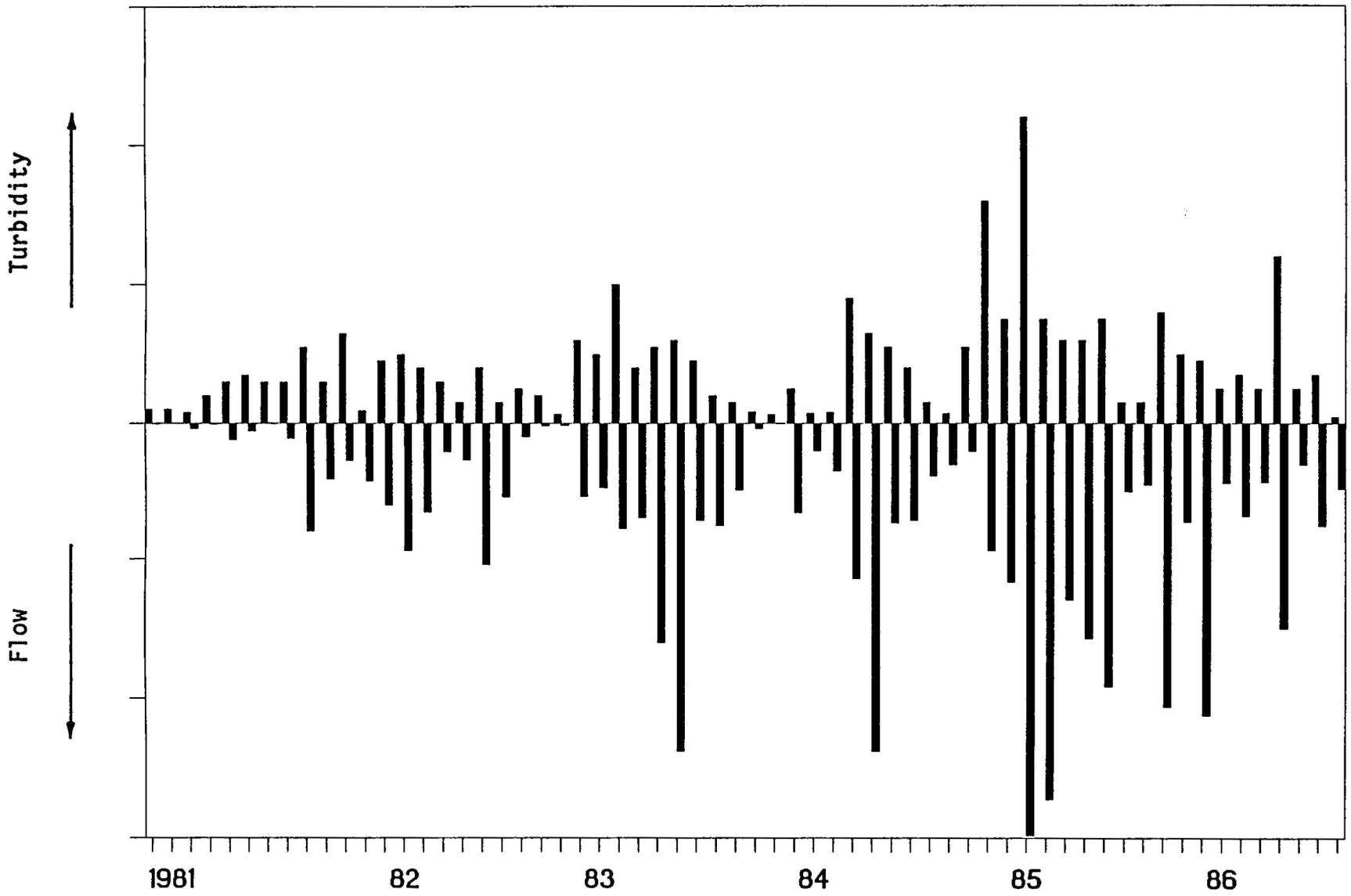

Figure 113. Graph of Turbidity And Flow Versus Time For The Van Buren Site 1981-1986.

hundred seventy-eight values were reported for this period of record. Figure 114 shows the alkalinity concentrations plotted as a function of time for this site. Both flow and alkalinity are shown versus time in Figure 115. As shown by the figure, there does not appear to be an obvious relationship between flow and alkalinity.

Chloride. Figure 116 shows the chloride concentrations plotted versus time for the period from July, 1969 until July, 1987. As shown by the figure, the chloride concentrations varied considerably during this period. The minimum and maximum concentrations were 21 and 320 mg/L, respectively. The average concentration was 110 mg/L. Figure 117 shows both flow and chloride plotted as a function of time. As shown by this figure, there was an apparent tendency for lower chloride concentrations at larger flows and larger chloride concentrations at smaller flows. One hundred sixty-six concentrations were reported for this time period.

Coliform. The coliform data were particularly interesting with respect to the decreasing coliform concentrations in the later years. The period of record was from July, 1969 until September, 1976. The average coliform concentration for the seventy-seven values reported was 6,630 organisms per one-hundred milliliters. The coliform counts ranged from 33 to 140,000. The data are shown in Figure 118. Figure 119 shows both coliform and flow plotted as a function of time.

Calcium. Figure 120 shows the calcium concentrations for the period of time from July, 1969 until July, 1987. The

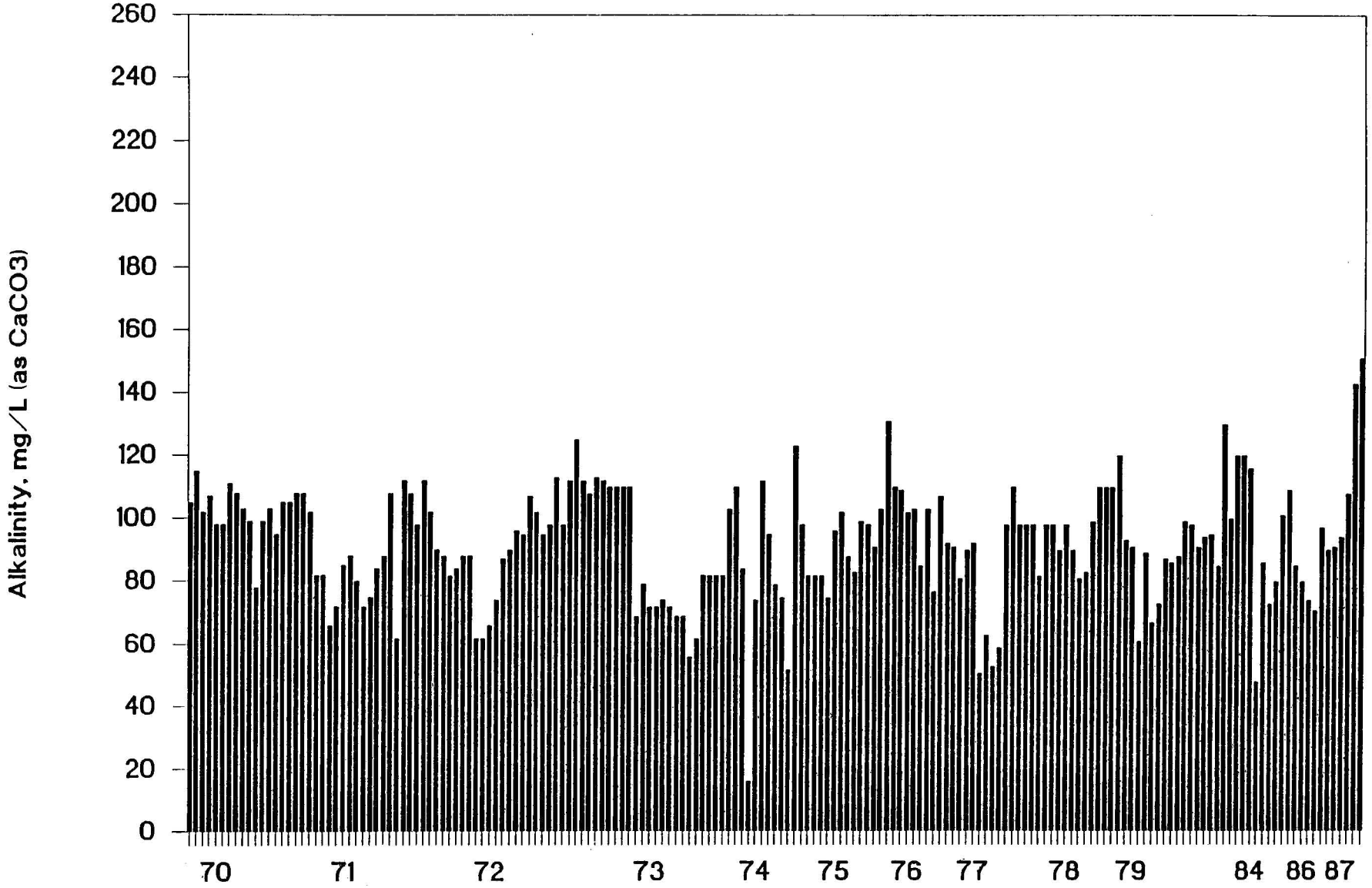

Figure 114. Graph of Alkalinity Versus Time For The Van Buren (Lock & Dam 13) Site 1969-1987.

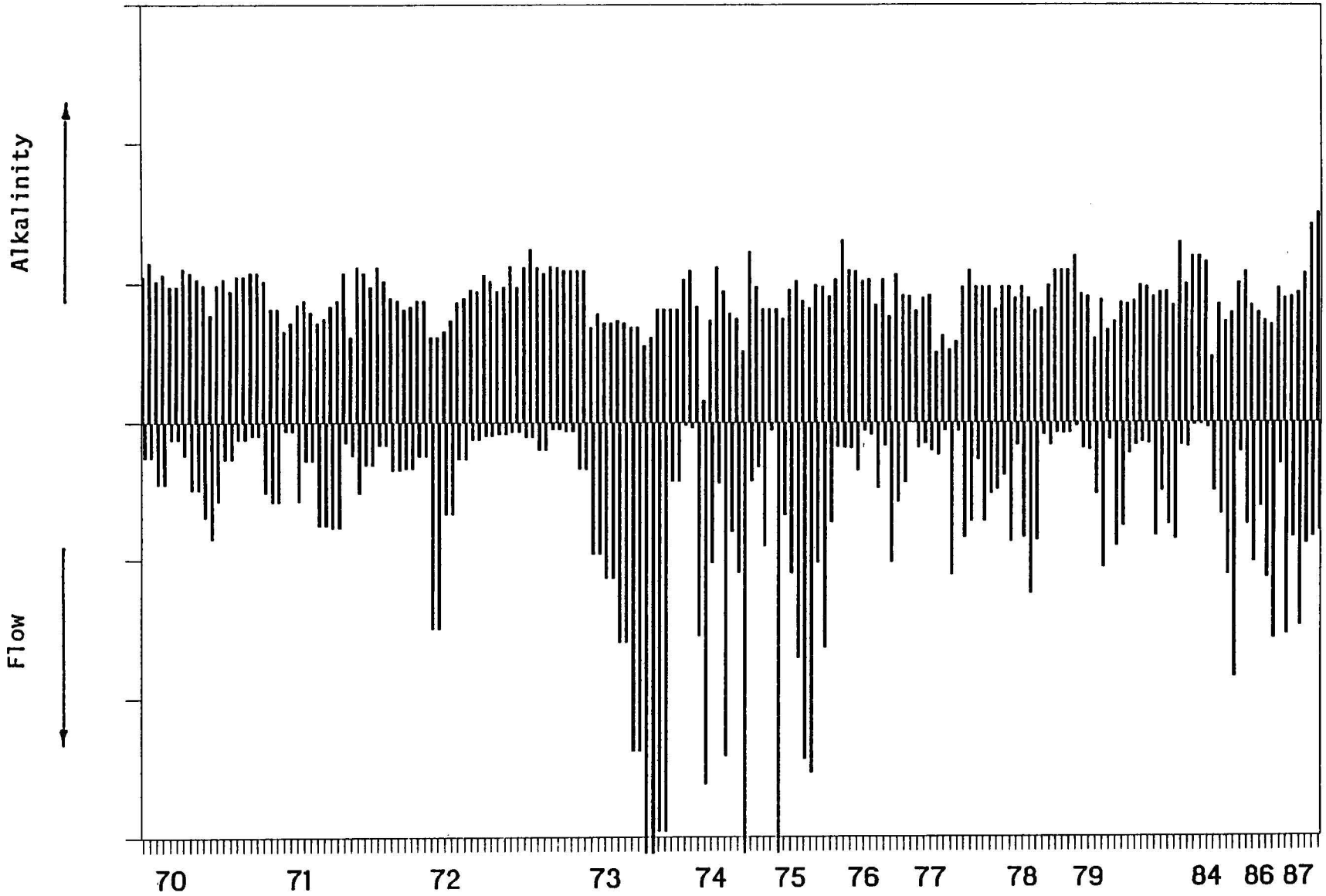

Figure 115. Graph of Alkalinity & Flow Versus Time For The Van Buren (Lock & Dam 13) Site 1969-1987.

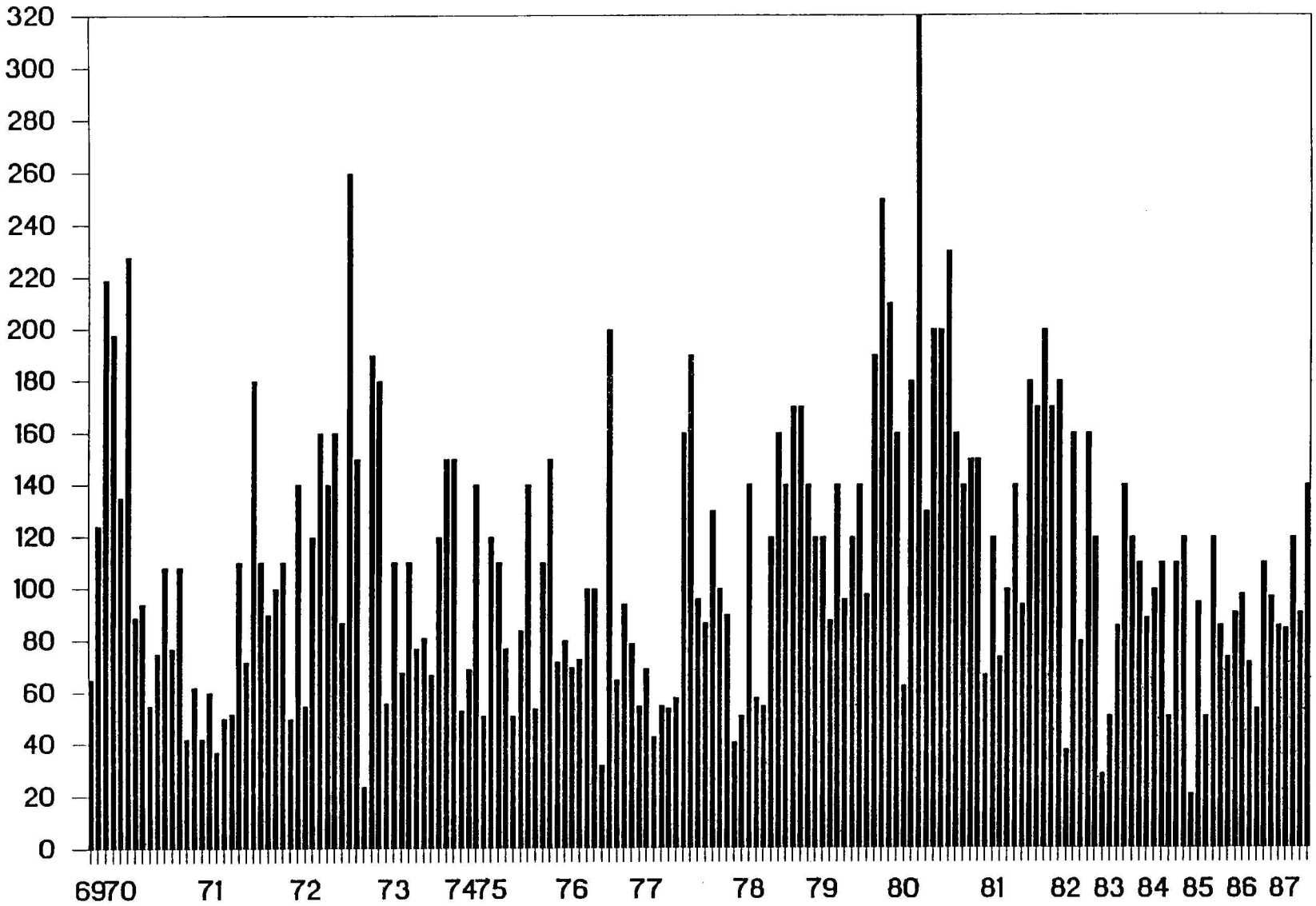

Figure 116. Graph of Chloride Versus Time For The Van Buren (Lock & Dam 13) Site 1969-1987.

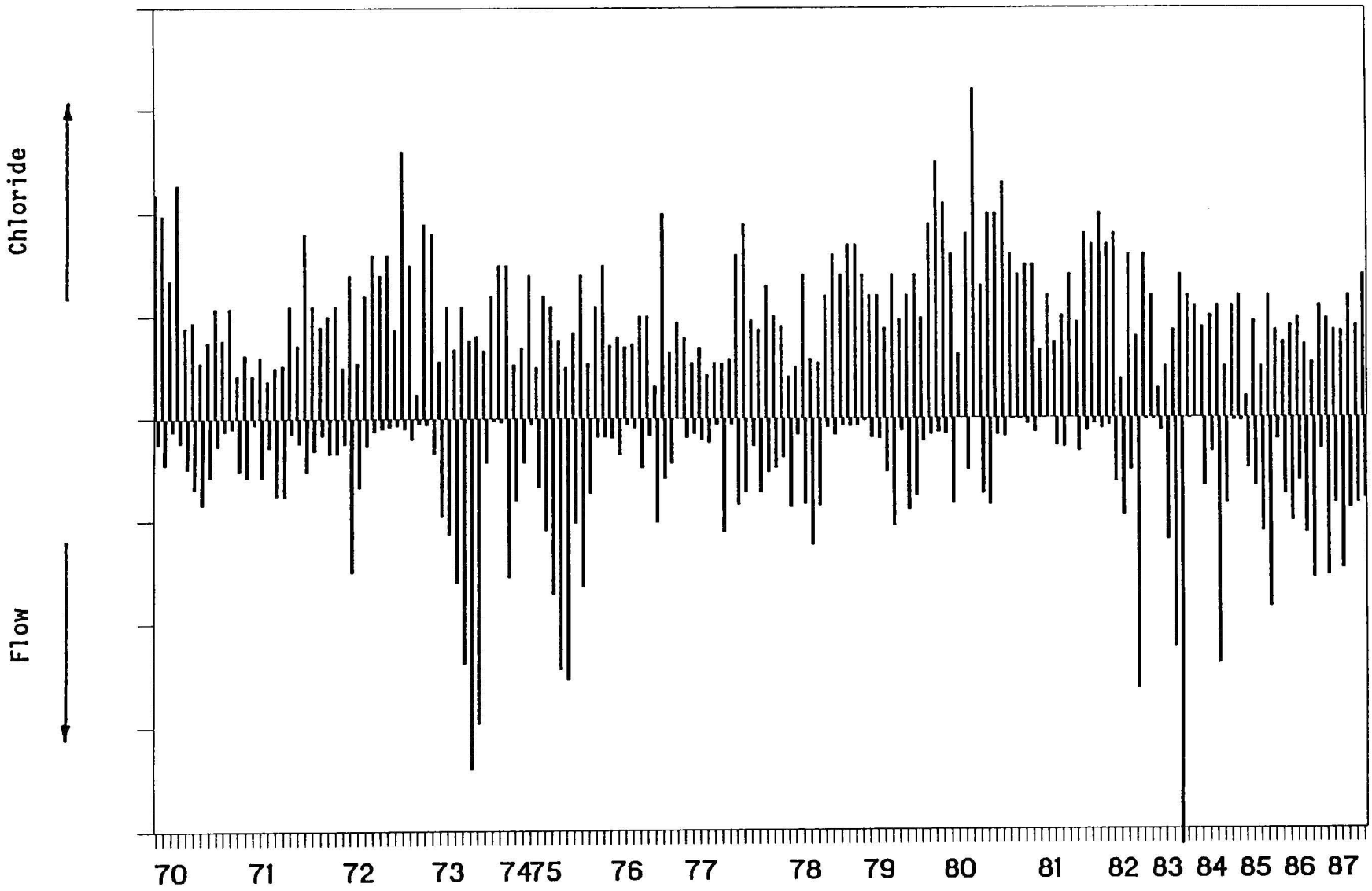

Figure 117. Graph of Chloride And Flow Versus Time For The Van Buren (Lock & Dam 13) Site 1969-1987.

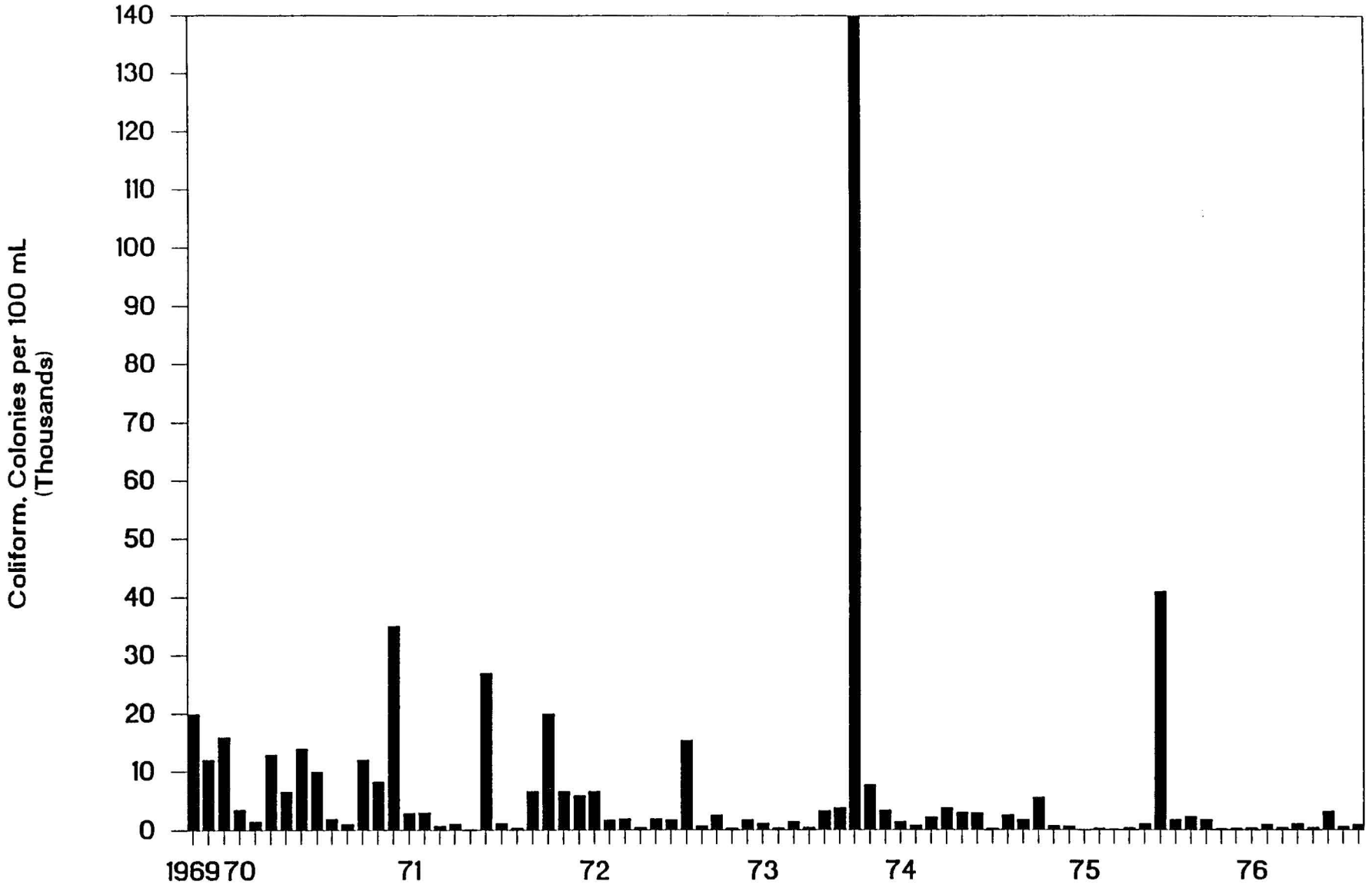

Figure 118. Graph of Coliform Versus Time For The Van Buren (Lock & Dam 13) Site 1969-1976.

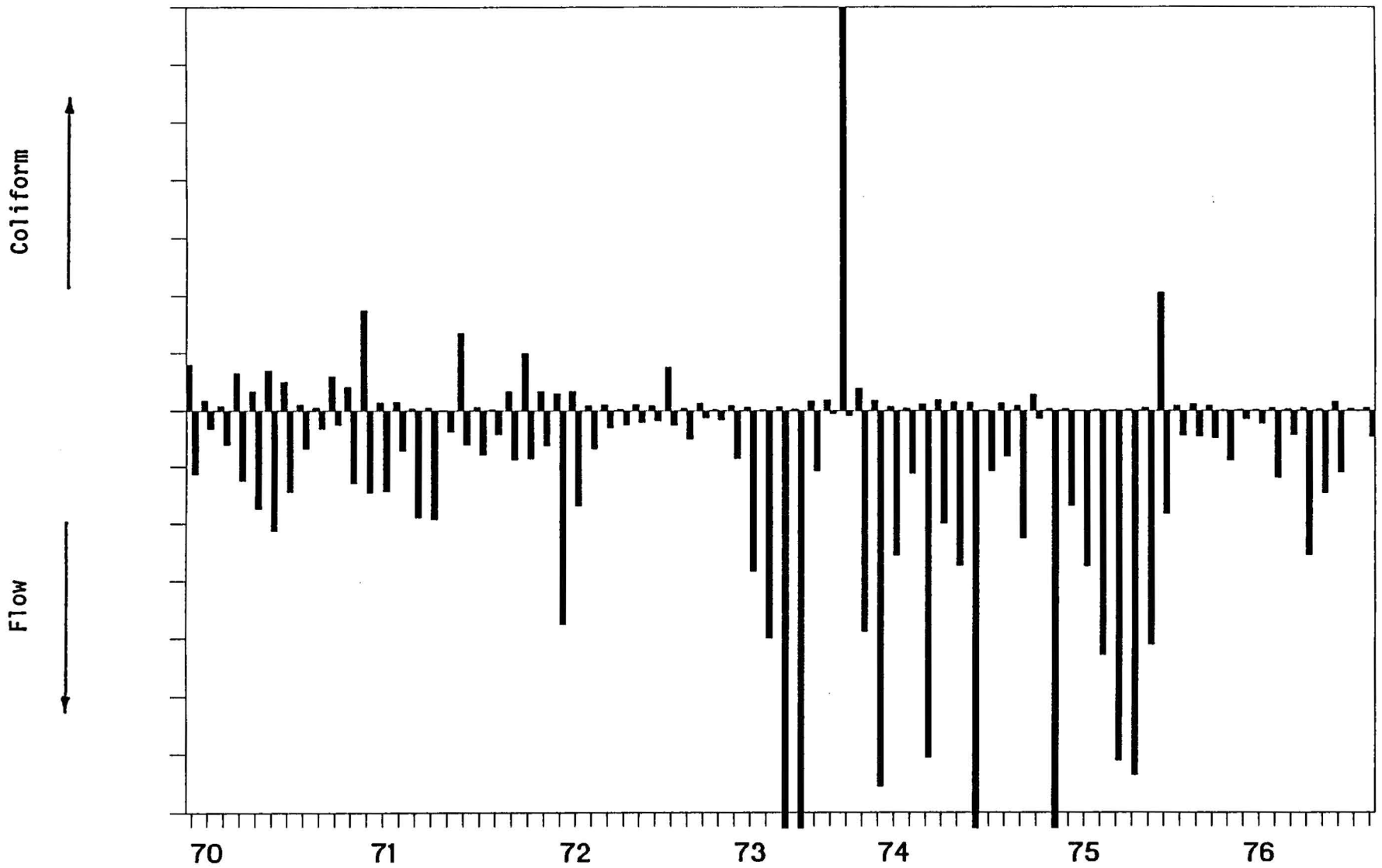

Figure 119. Graph of Coliform And Flow Versus Time For The Van Buren (Lock & Dam 13) Site 1969-1987.

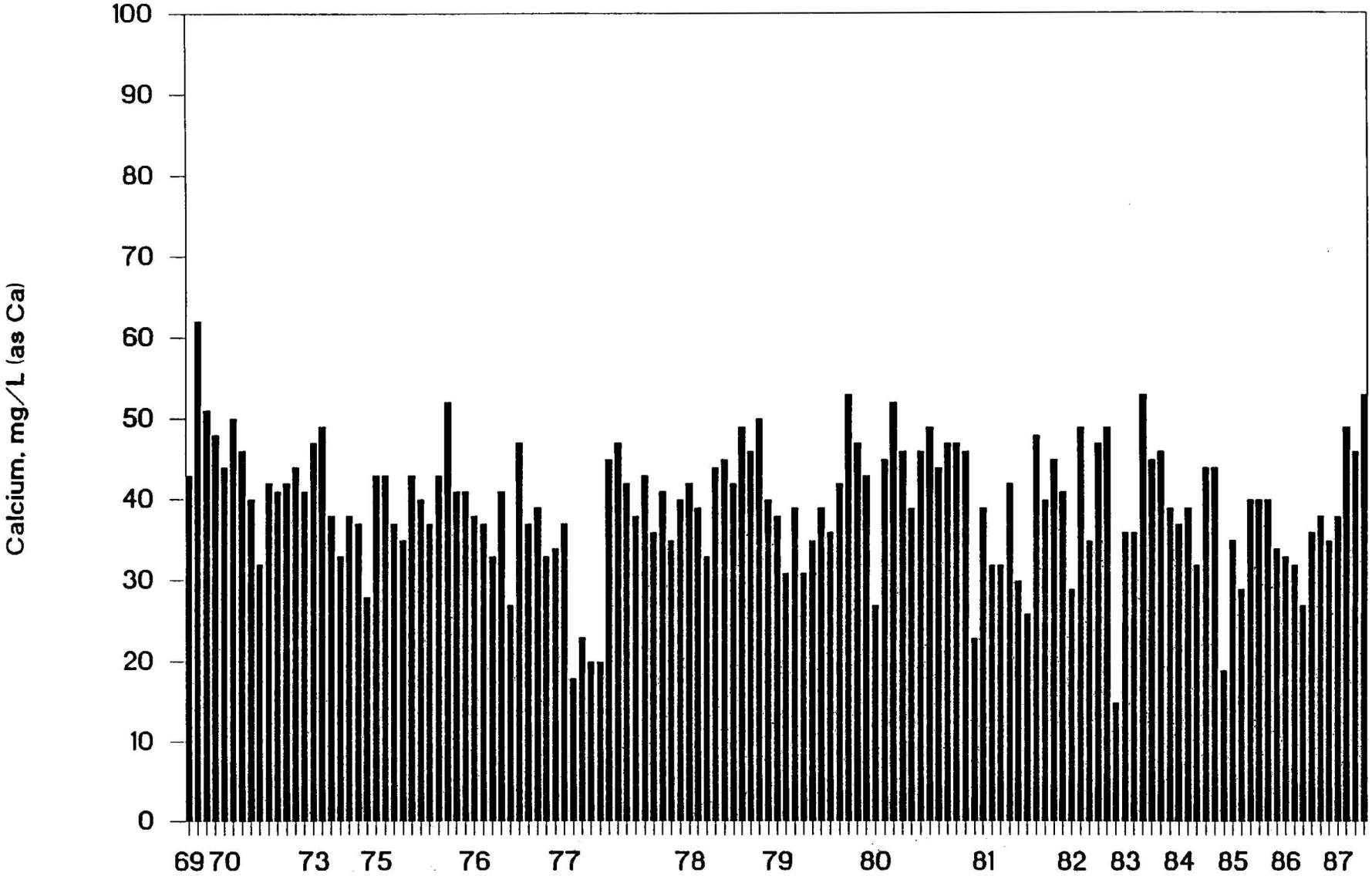

Figure 120. Graph of Calcium Versus Time For The Van Buren (Lock & Dam 13) Site 1969-1987.

average concentration for the 133 values reported was 39 mg/L, expressed as calcium. The concentrations ranged from 15 to 62 mg/L. Figure 121 shows both calcium and flow plotted versus time for this site.

Dissolved Solids. The average dissolved solids concentration was 362 mg/L for the 130 values reported. The dissolved solids concentrations ranged from 109 to 820 mg/L. Figure 122 shows dissolved solids versus time for the period of time from July, 1969 until July, 1987. A graph of both flow and dissolved solids plotted as a function of time is shown in Figure 123.

pH. The average pH value at this site was 7.9. The minimum and maximum values were 6.4 and 8.8, respectively.

Sodium. Figure 124 shows the sodium concentrations as a function of time for the period from July, 1969 until July, 1987. The average of the 130 values reported was 73 mg/L, expressed as sodium. The minimum and maximum concentrations were 12 and 200 mg/L, respectively. Flow and sodium are shown graphically versus time in Figure 125.

Sulfate. The average sulfate concentration was 46 mg/L. The range of concentrations was from 21 to 84 mg/L for the 166 sulfate values reported. The period of record was from July, 1969 until July, 1987. Figure 126 shows the sulfate concentrations plotted as a function of time. Similarly, Figure 127 shows both sulfate and flow plotted versus time.

Total Hardness. The average total hardness concentration for the 142 values reported was 134 mg/L, expressed as calcium carbonate. The data ranged from 55 to 204 mg/L for the

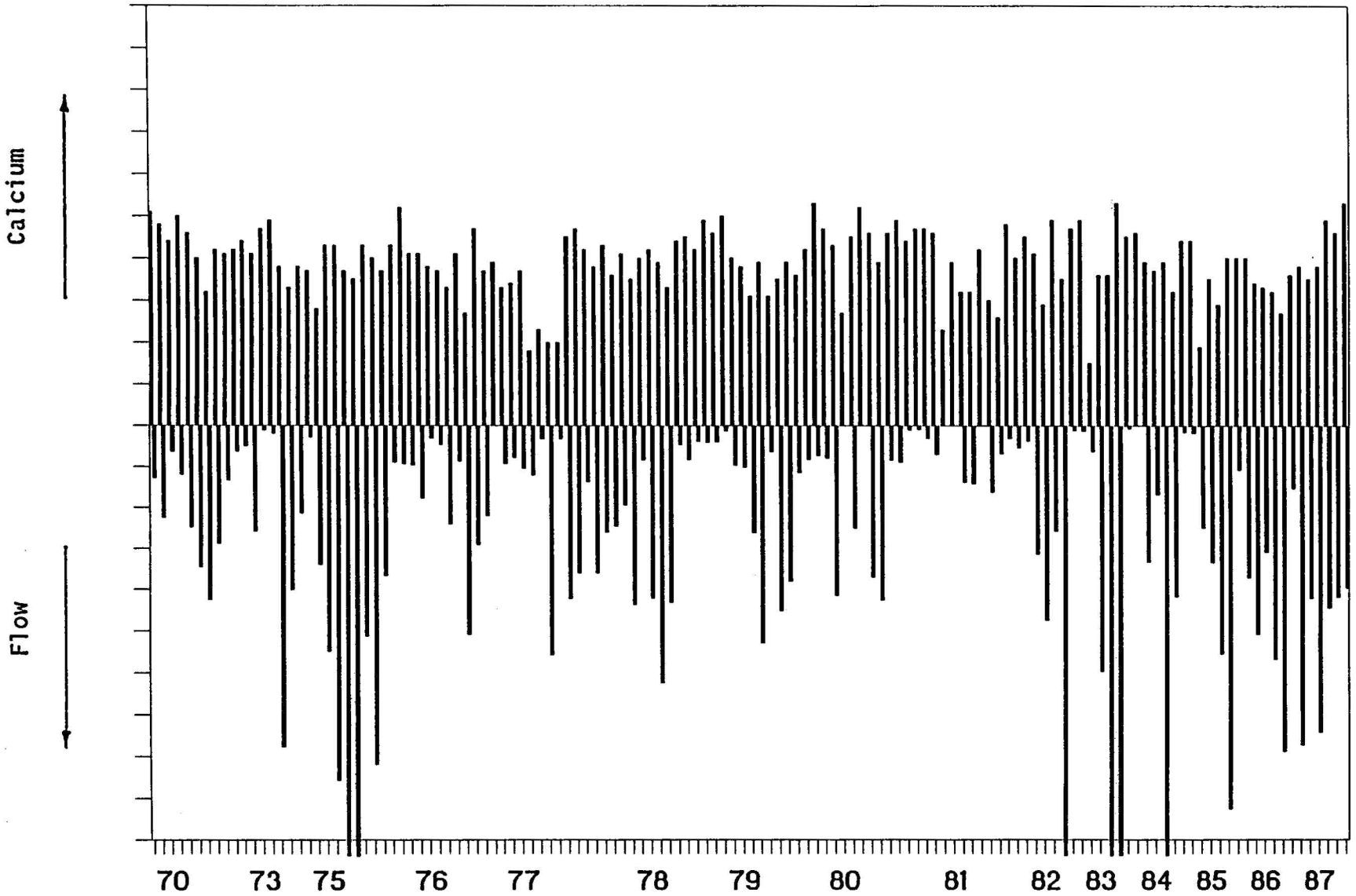

Figure 121. Graph of Calcium And Flow Versus Time For The Van Buren (Lock & Dam 13) Site 1969-1987.

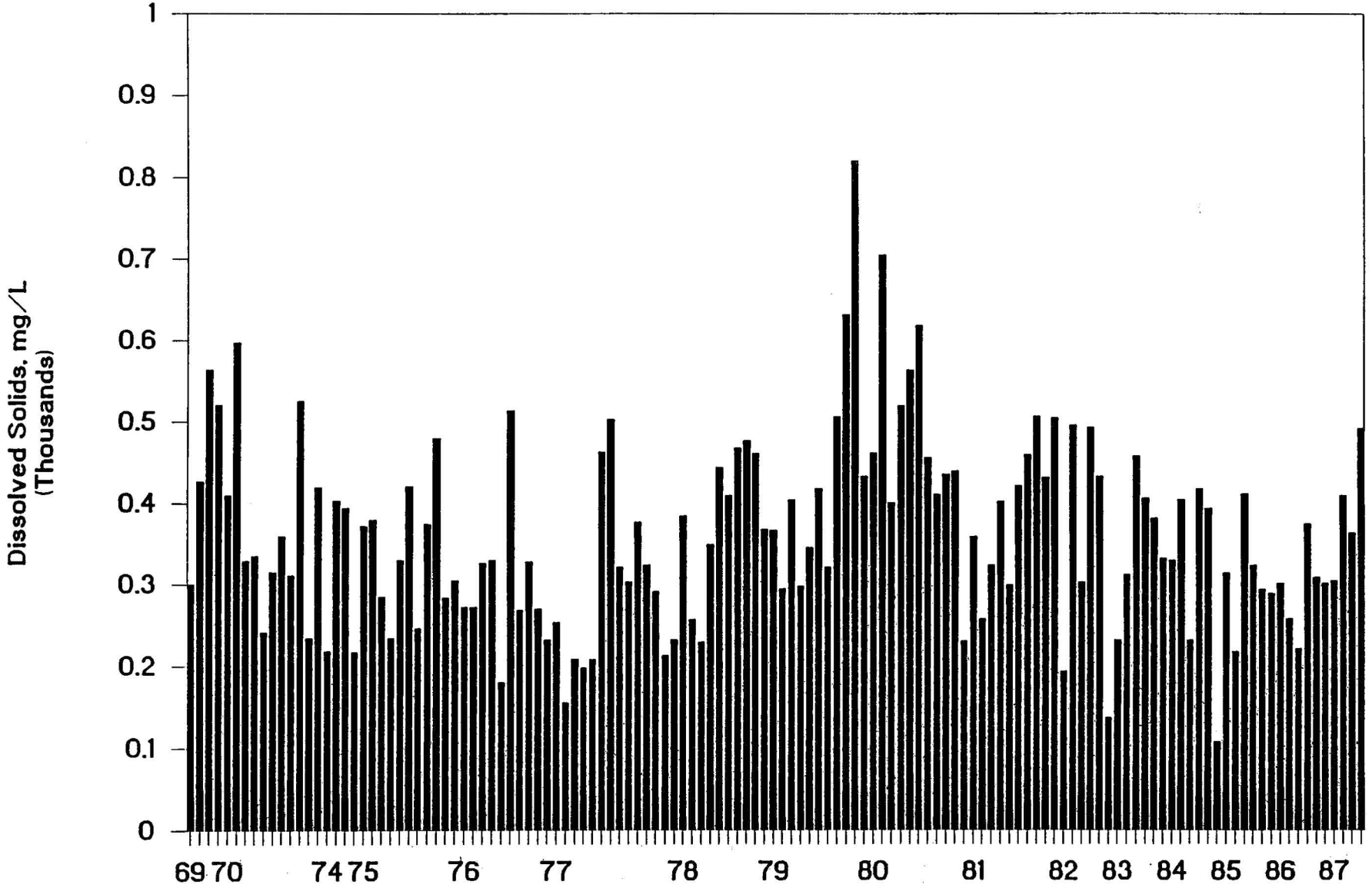

Figure 122. Graph of Dissolved Solids Versus Time For The Van Buren (Lock & Dam 13) Site 1969-1987.

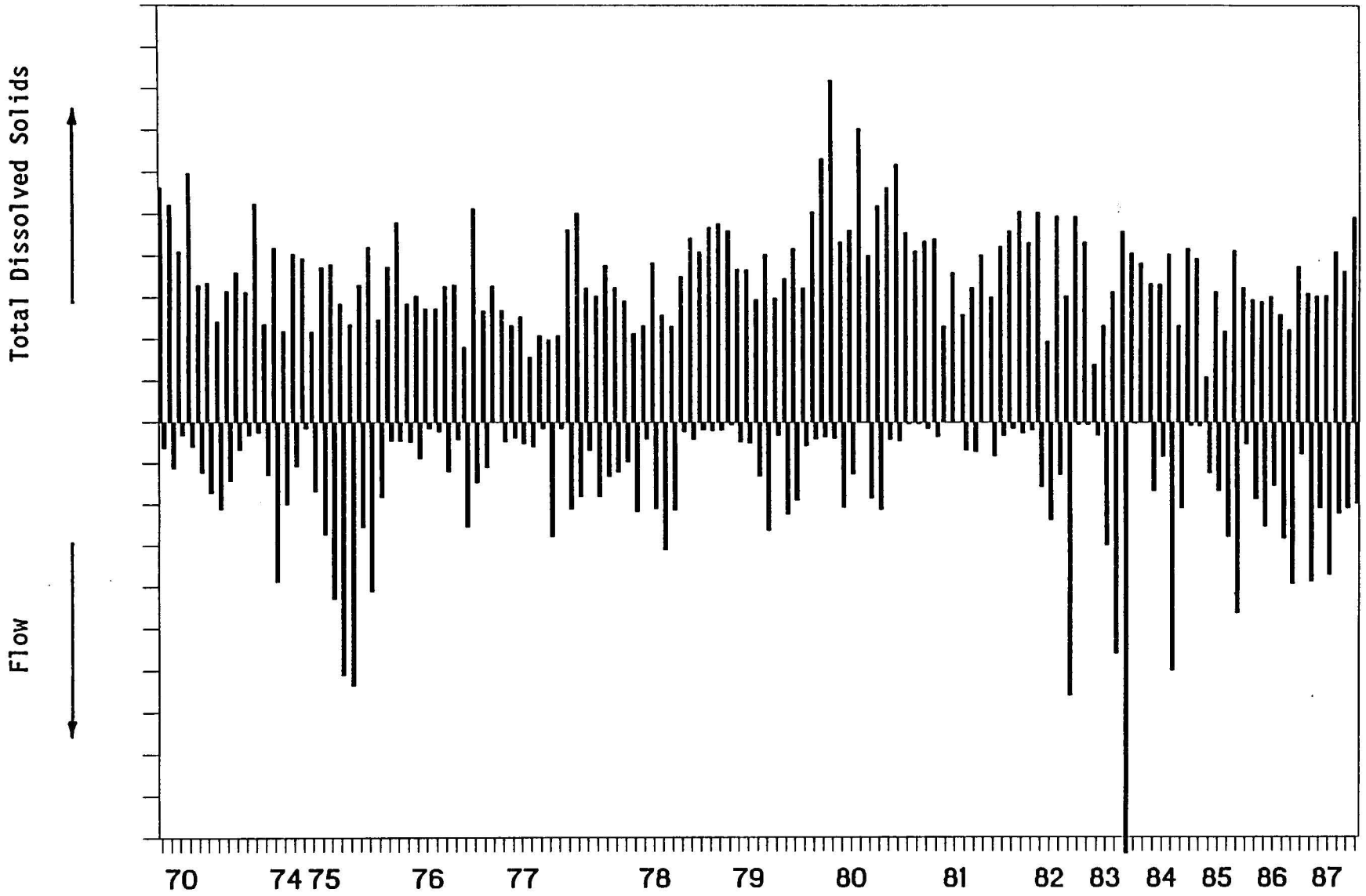

Figure 123. Graph of Dissolved Solids And Flow Versus Time For The Van Buren (Lock & Dam 13) Site 1969-1987.

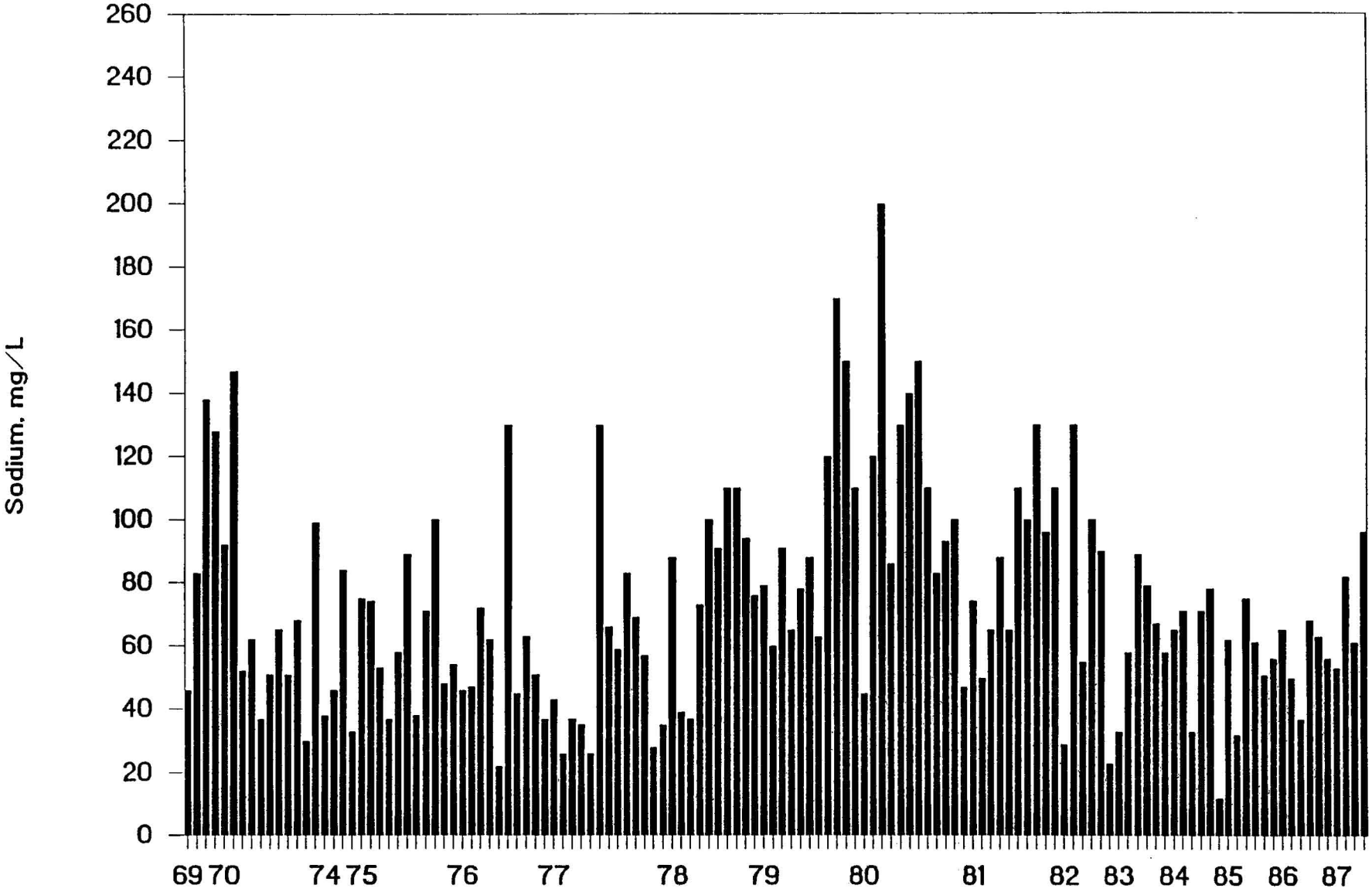

Figure 124. Graph of Sodium Versus Time For The Van Buren (Lock & Dam 13) Site 1969-1987.

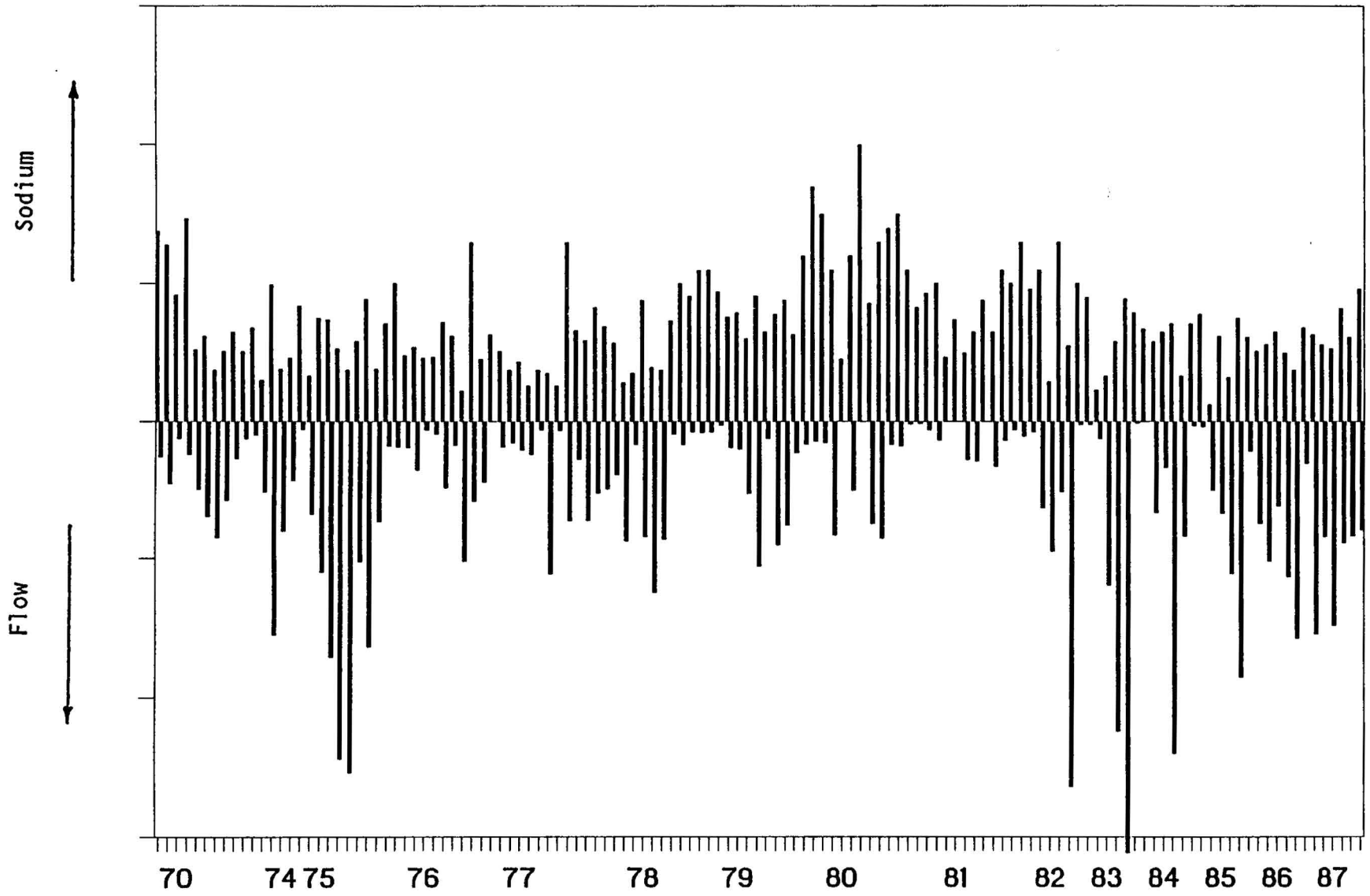

Figure 125. Graph of Sodium And Flow Versus Time For The Van Buren (Lock & Dam 13) Site 1969-1987.

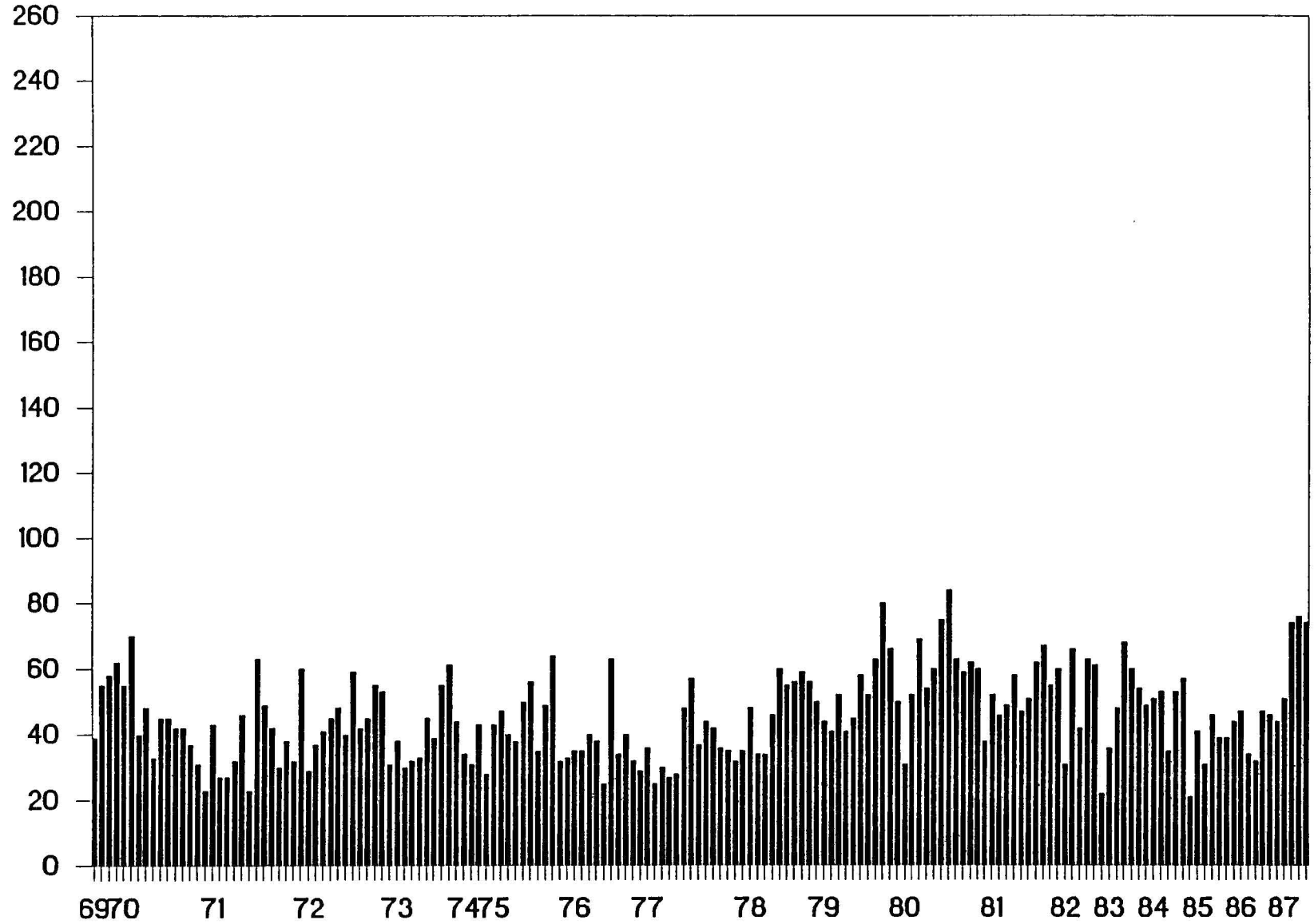

Figure 126. Graph of Sulfate Versus Time For The Van Buren (Lock & Dam 13) Site 1969-1987.

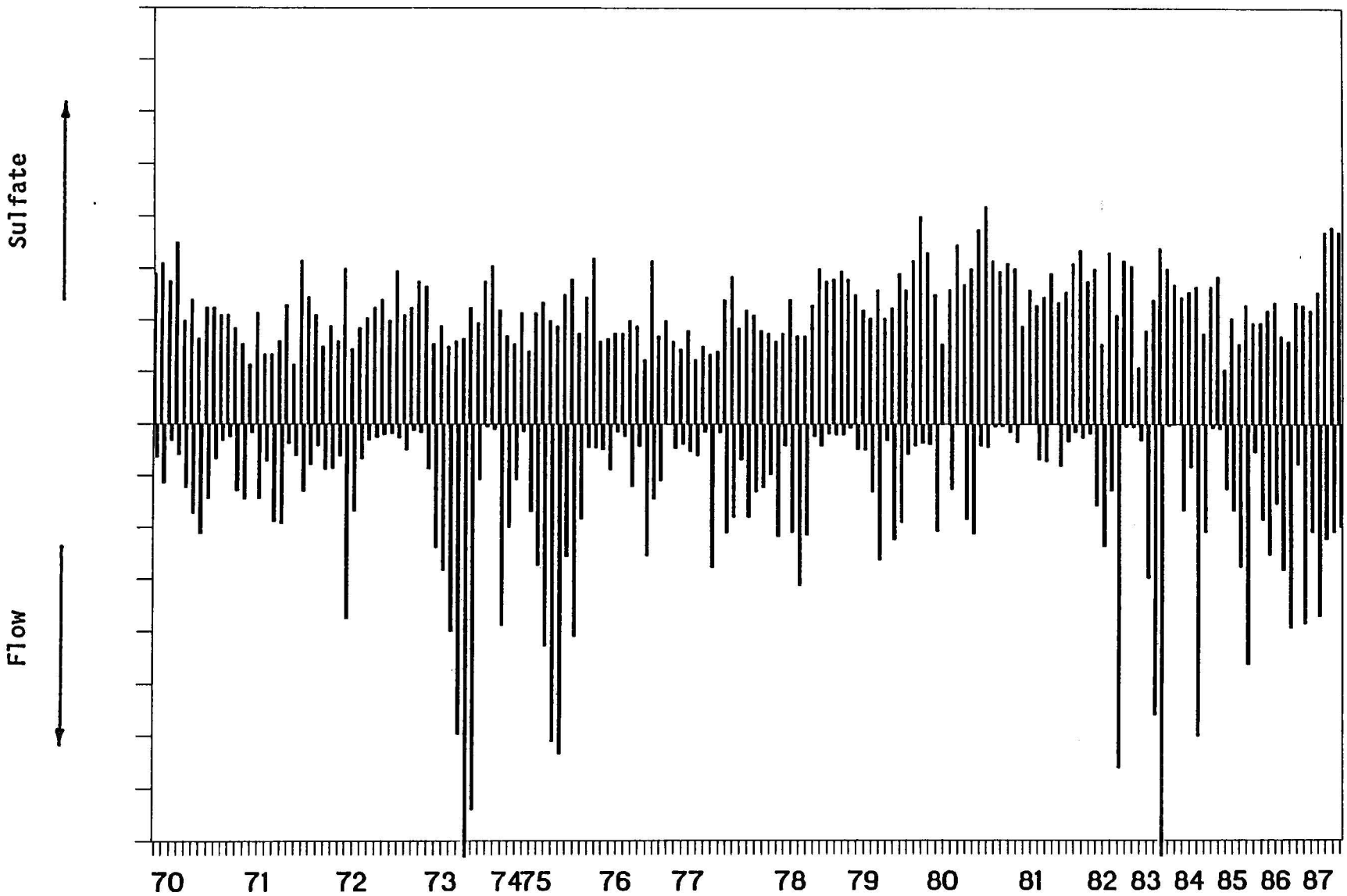

Figure 127. Graph of Sulfate And Flow Versus Time For The Van Buren (Lock & Dam 13) Site 1969-1987.

period of record from July, 1969 until February, 1986. The total hardness data are shown graphically in Figure 128. Figure 129 shows both flow and total hardness versus time.

Turbidity. The turbidity data ranged from 1 to 70 turbidity units for the 74 turbidity values reported. The average was 21. The period of record was from July, 1978 until July, 1987. Figure 130 shows the turbidity values plotted as a function of time for this site. Both flow and turbidity are plotted versus time in Figure 131.

Ozark Dam

The Ozark Dam sampling site is at Mile 272.9. The site is located 1.0 mile southeast of Ozark.

Alkalinity. The average alkalinity concentration at this site was 94 mg/L. The concentrations ranged from 65 to 120 mg/L for the 21 values reported. The data are shown in Figure 132. The period of record was from 1974 until 1980.

Chloride. The chloride data are shown in Figure 133. The minimum and maximum concentrations were 50 and 350 mg/L, respectively. The average concentration was 106 mg/L for the 129 concentrations reported. Figure 134 shows both chloride and flow plotted as a function of time. As shown by the figure, there was a general tendency for larger chloride concentrations at lower flows and smaller chloride concentrations at larger flows. The period of record included data from 1975 until 1986.

Coliform. The average coliform count was 232 colonies per 100 mL. The minimum and maximum counts were 4 and 4,200

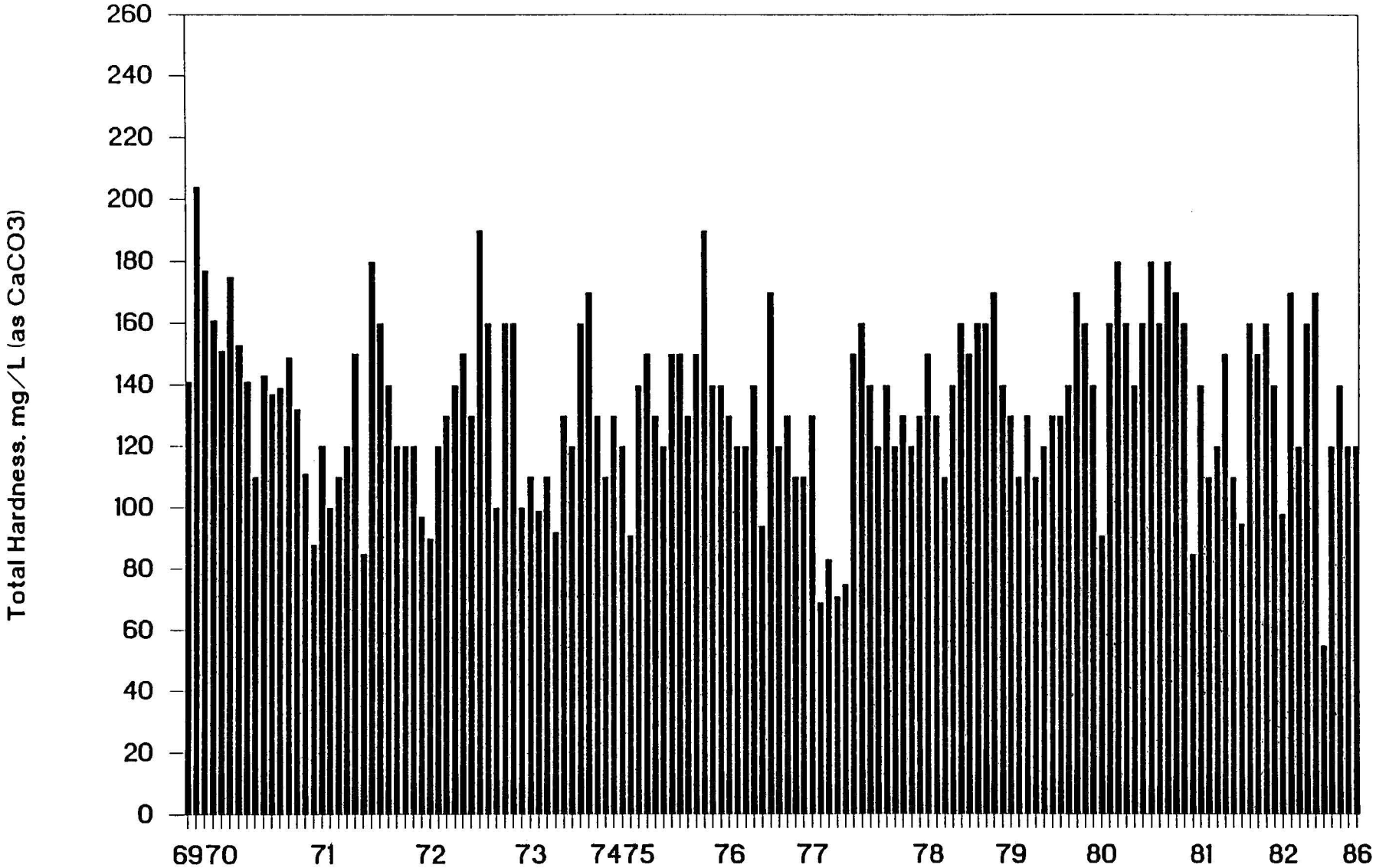

Figure 128. Graph of Total Hardness Versus Time For The Van Buren (Lock & Dam 13) Site 1969-1987.

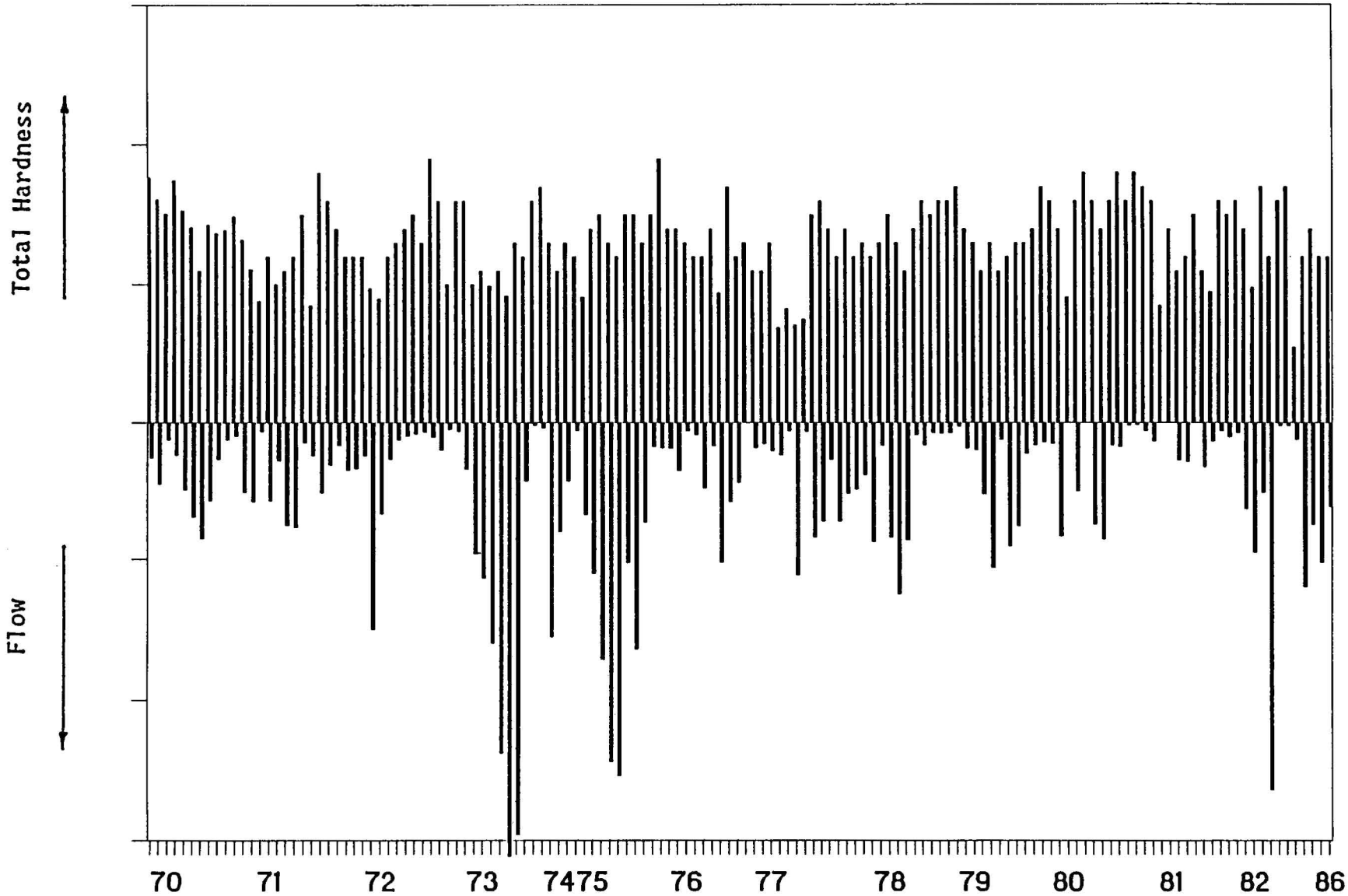

Figure 129. Graph of Total Hardness And Flow Versus Time For The Van Buren (Lock & Dam 13) Site 1969-1987.

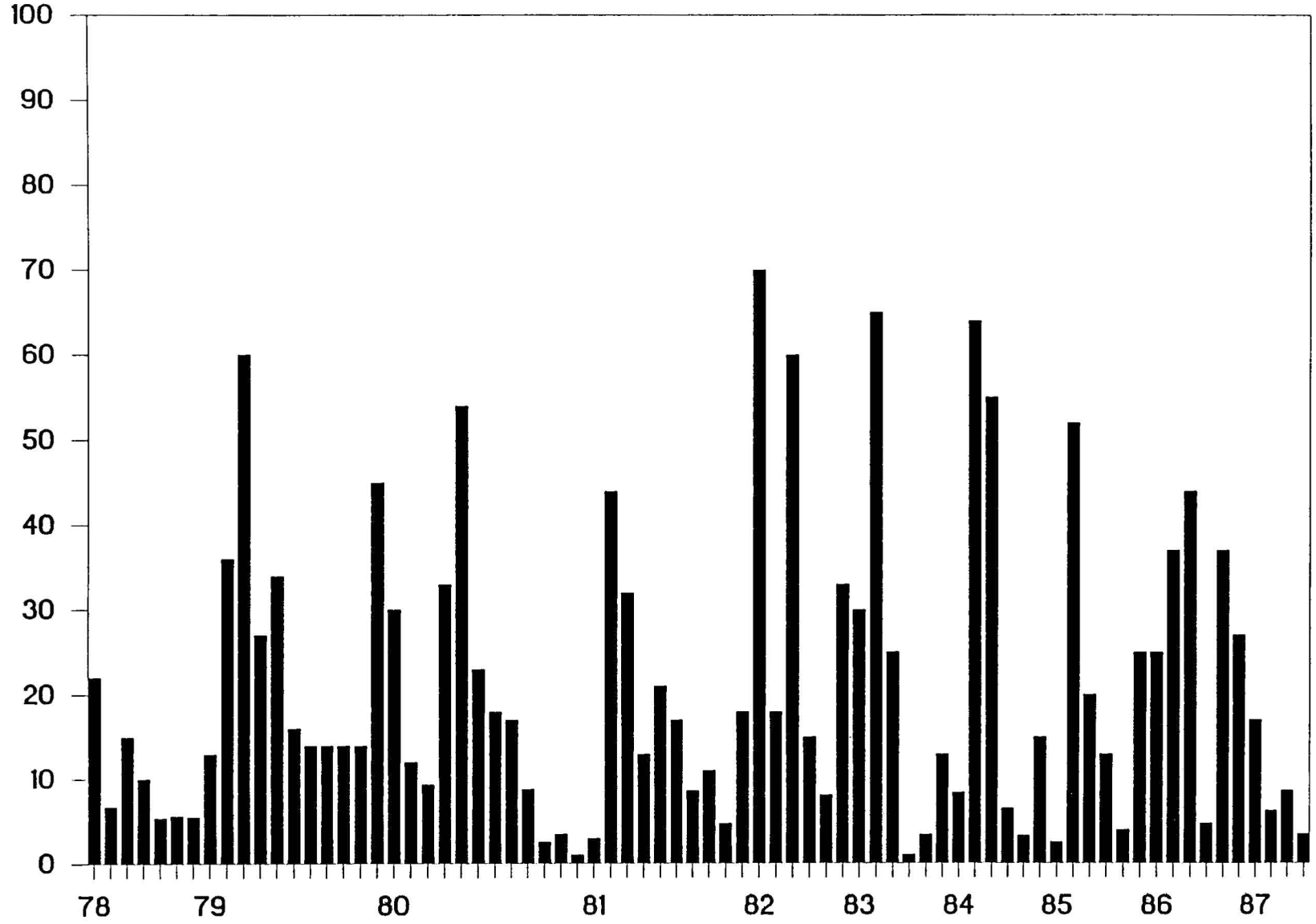

Figure 130. Graph of Turbidity Versus Time For The Van Buren (Lock & Dam 13 Site 1969-1987.

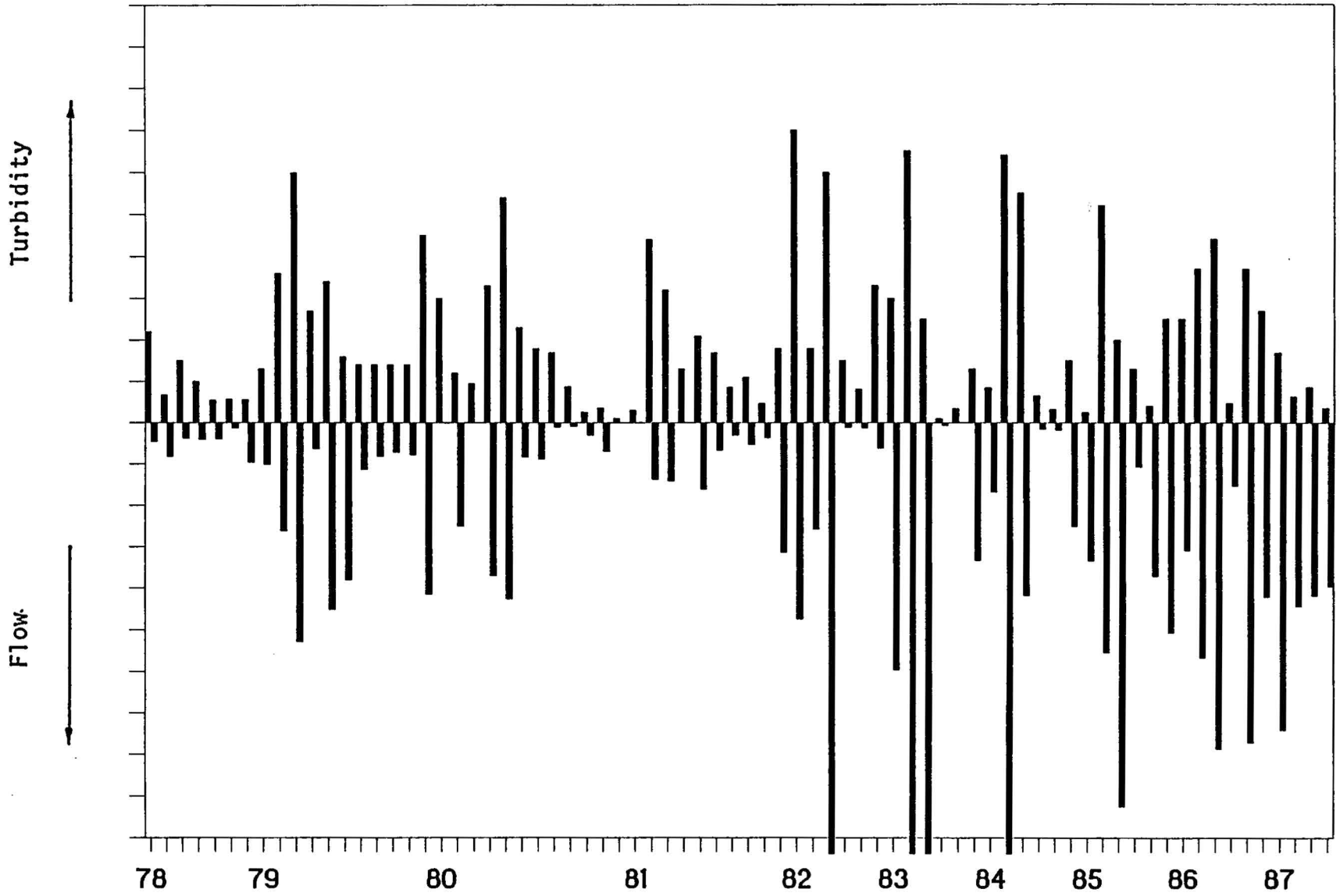

Figure 131. Graph of Turbidity And Flow Versus Time For The Van Buren (Lock & Dan 13 Site) 1978-1987.

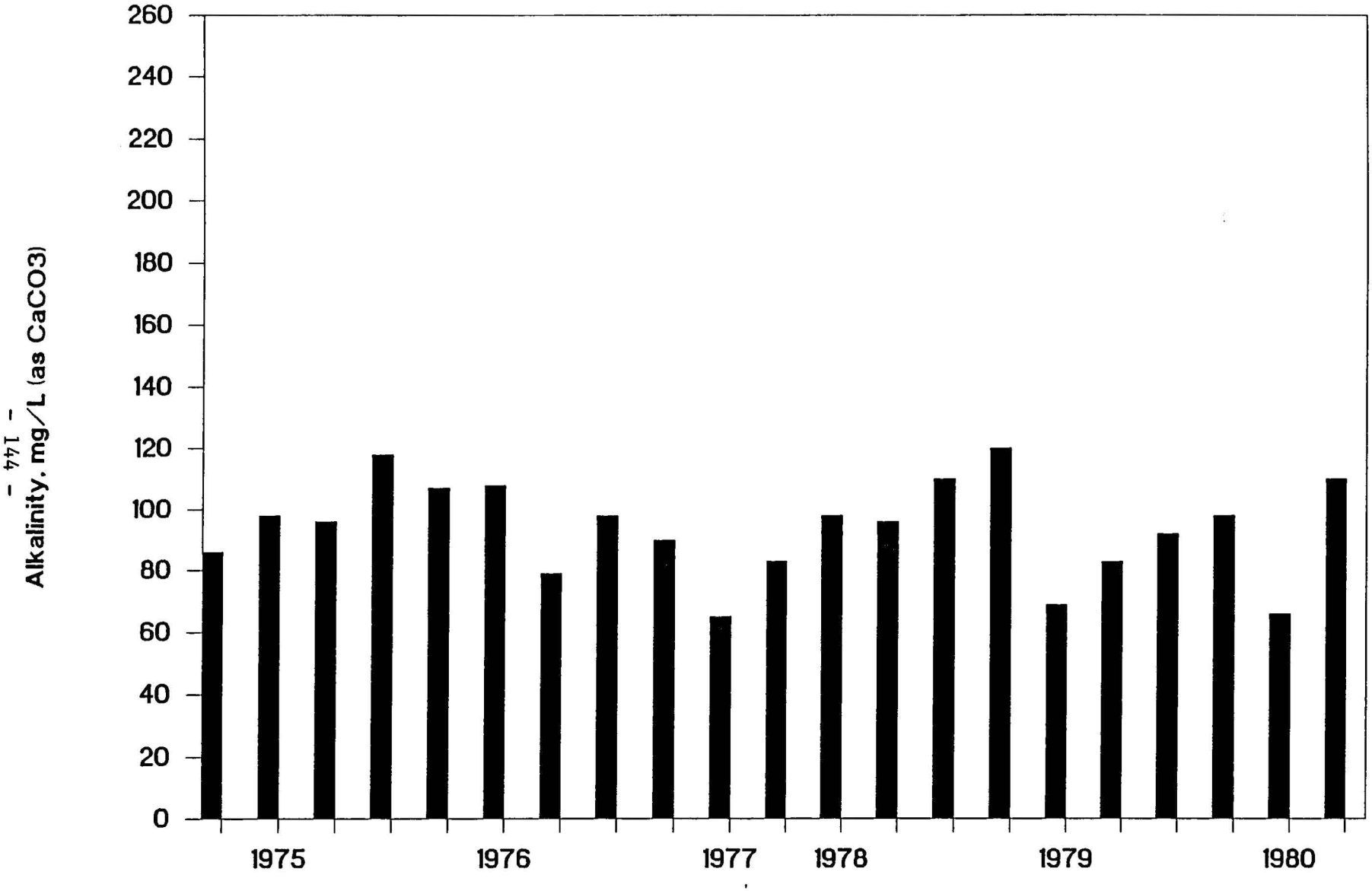

Figure 132. Graph of Alkalinity Versus Time For The Ozark Dan Site 1974-1981.

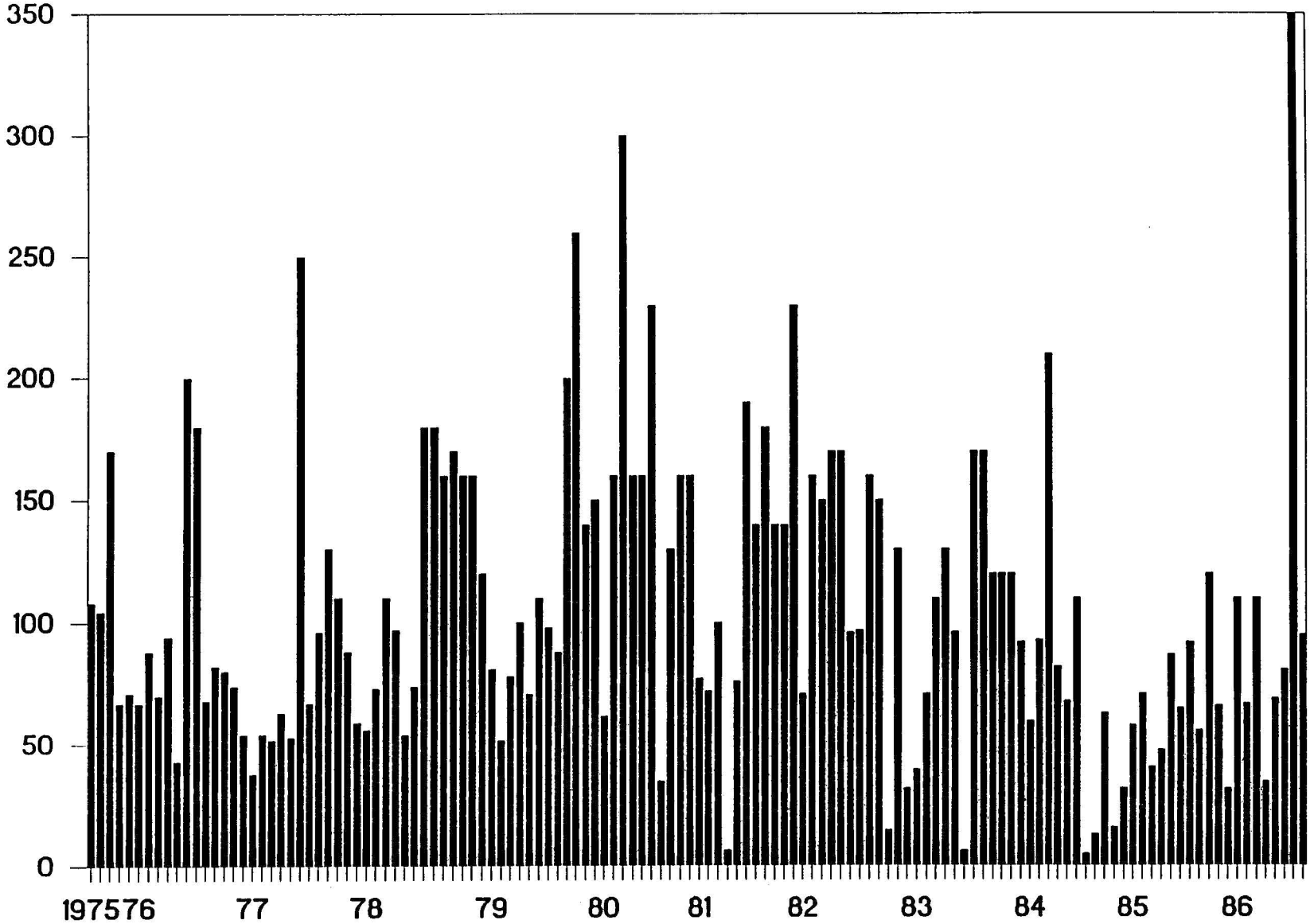

Figure 133. Graph of Chloride Versus Time For The Ozark Dam Site 1975-1986.

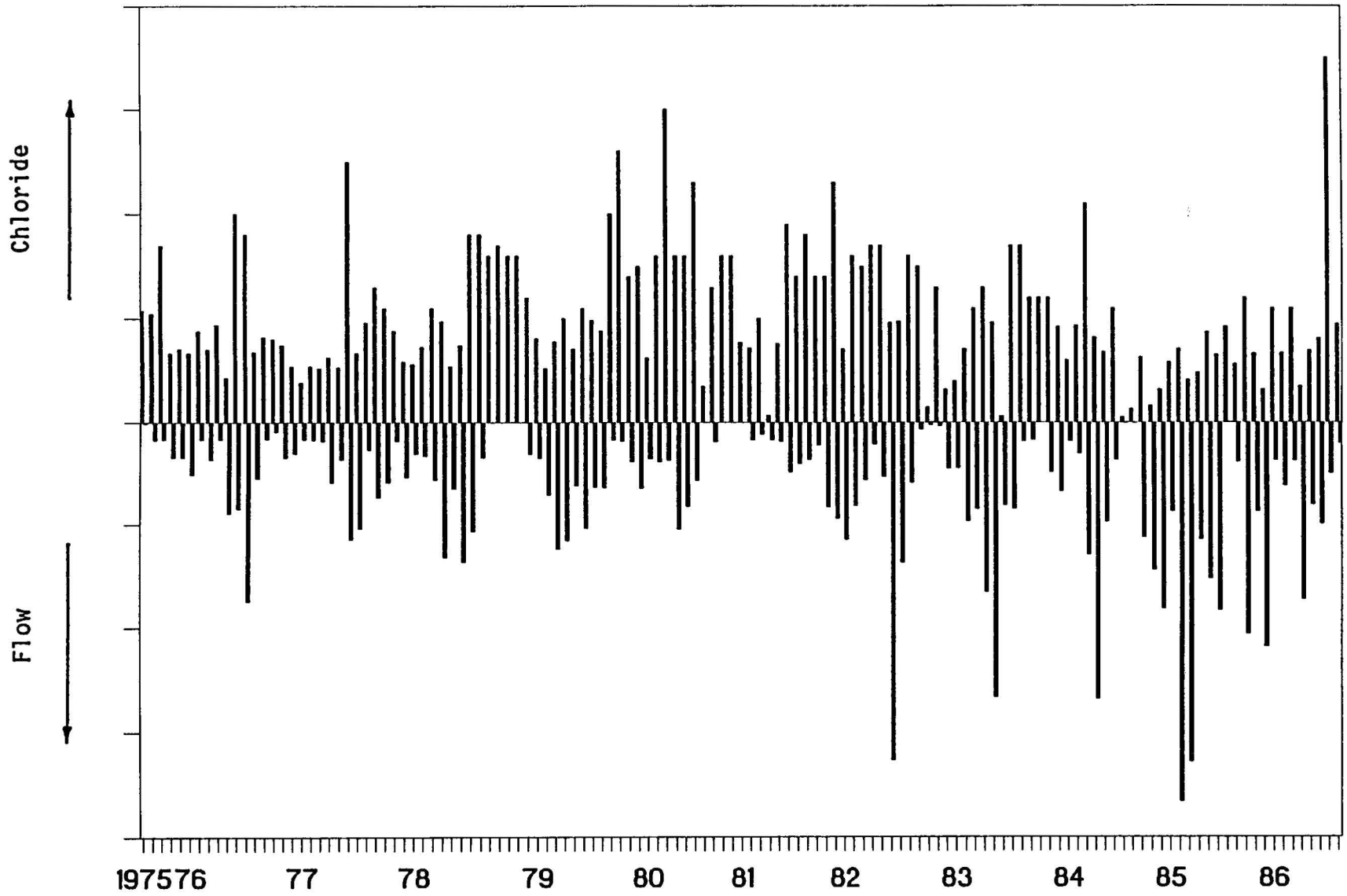

Figure 134. Graph of Chloride And Flow Versus Time For The Ozark Dam Site 1975-1986.

colonies, respectively. The coliform data are shown in Figure 135. One-hundred twenty-five coliform counts were included in the data base. It is interesting to note that the coliform concentrations were much smaller from about 1979 until 1986 than for prior years. Coliforms and flow are both plotted in Figure 136 as a function of time.

Calcium. The average calcium concentration was 35 mg/L (as calcium). The minimum and maximum concentrations were 25 and 41 mg/L, respectively. Only eight calcium concentrations were reported.

pH. The average pH value was 8.0. The minimum and maximum pH values were 6.8 and 8.9, respectively. The data base included 141 pH values.

Potassium. The potassium concentrations ranged from 1 to 6 mg/L with an average concentration of 3.8 mg/L. Twenty-two values were included in the record. The data are shown graphically in Figure 137.

Suspended Solids. Figure 138 shows the suspended solids concentrations for the Ozark Dam site. The concentrations ranged from 8 to 183 mg/L with an average concentration of 30 mg/L. The record included 134 concentrations. Figure 139 shows both suspended solids and flow plotted as a function of time. As would be expected, there was a tendency for larger suspended solids concentrations at larger flow rates and smaller suspended solids concentrations at lower flow rates.

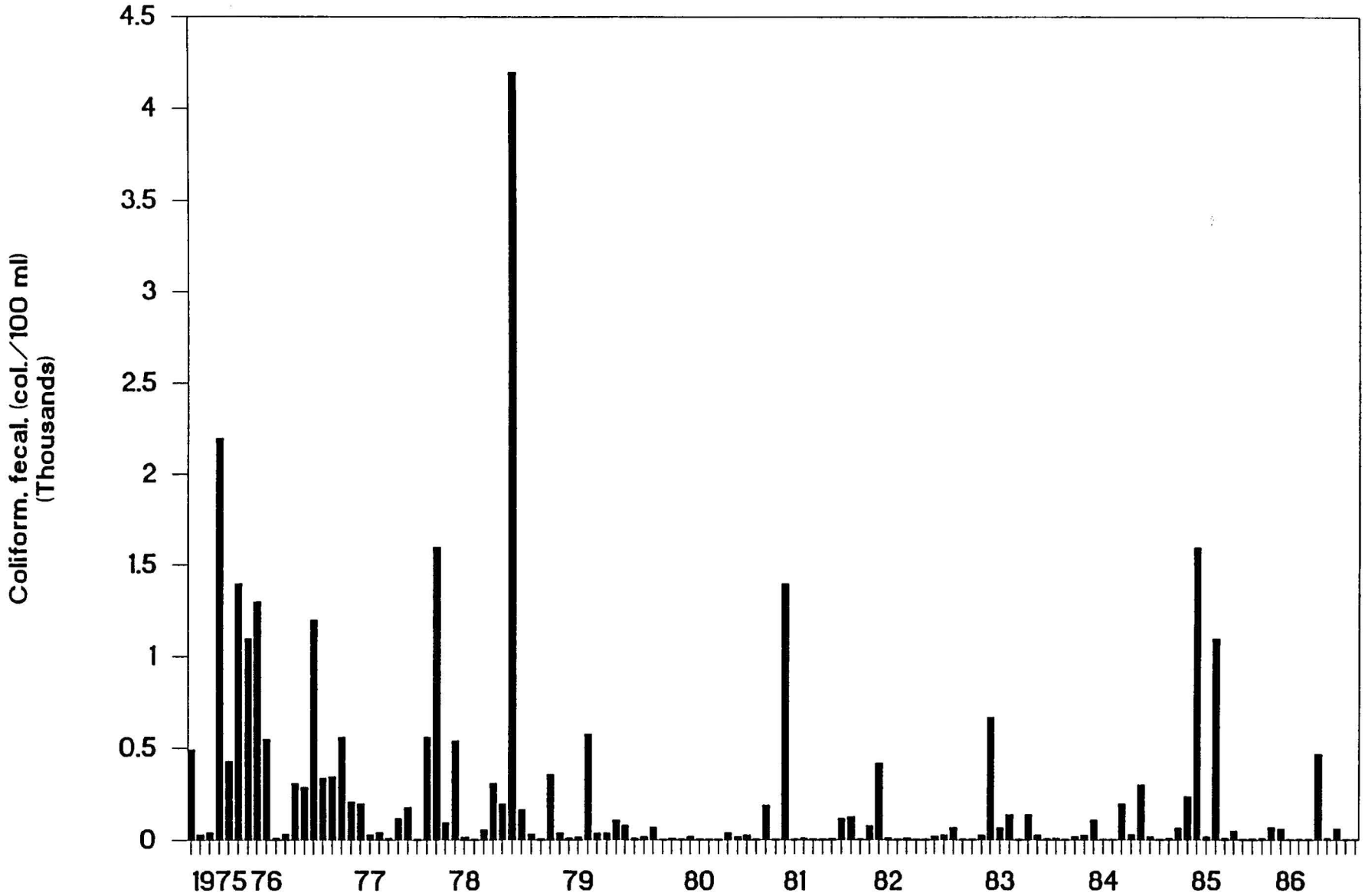

Figure 135. Graph of Coliform Versus Time For The Ozark Dam Site 1975-1986.

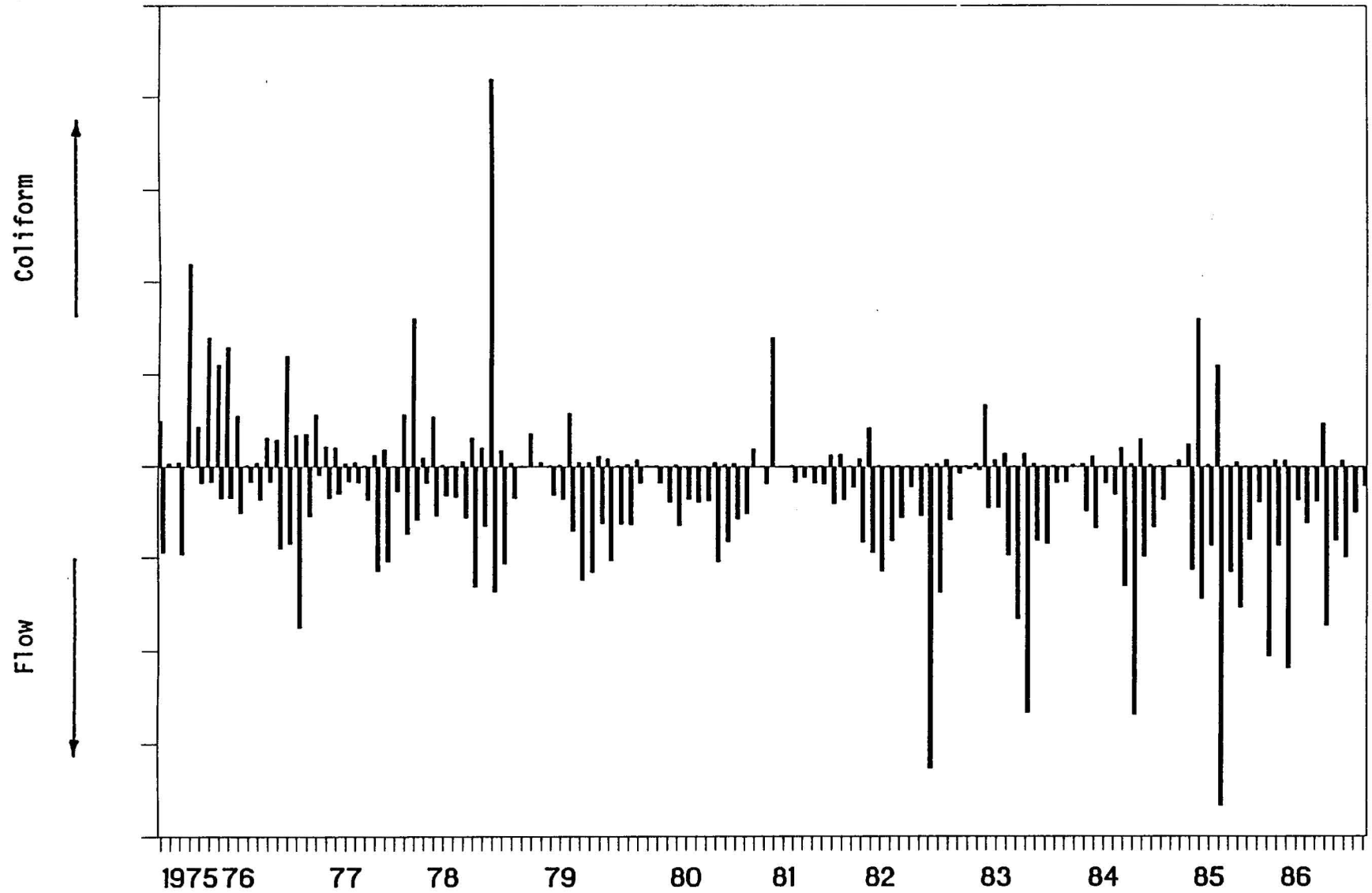

Figure 136. Graph of Coliform And Flow Versus Time For The Ozark Dam Site 1975-1986.

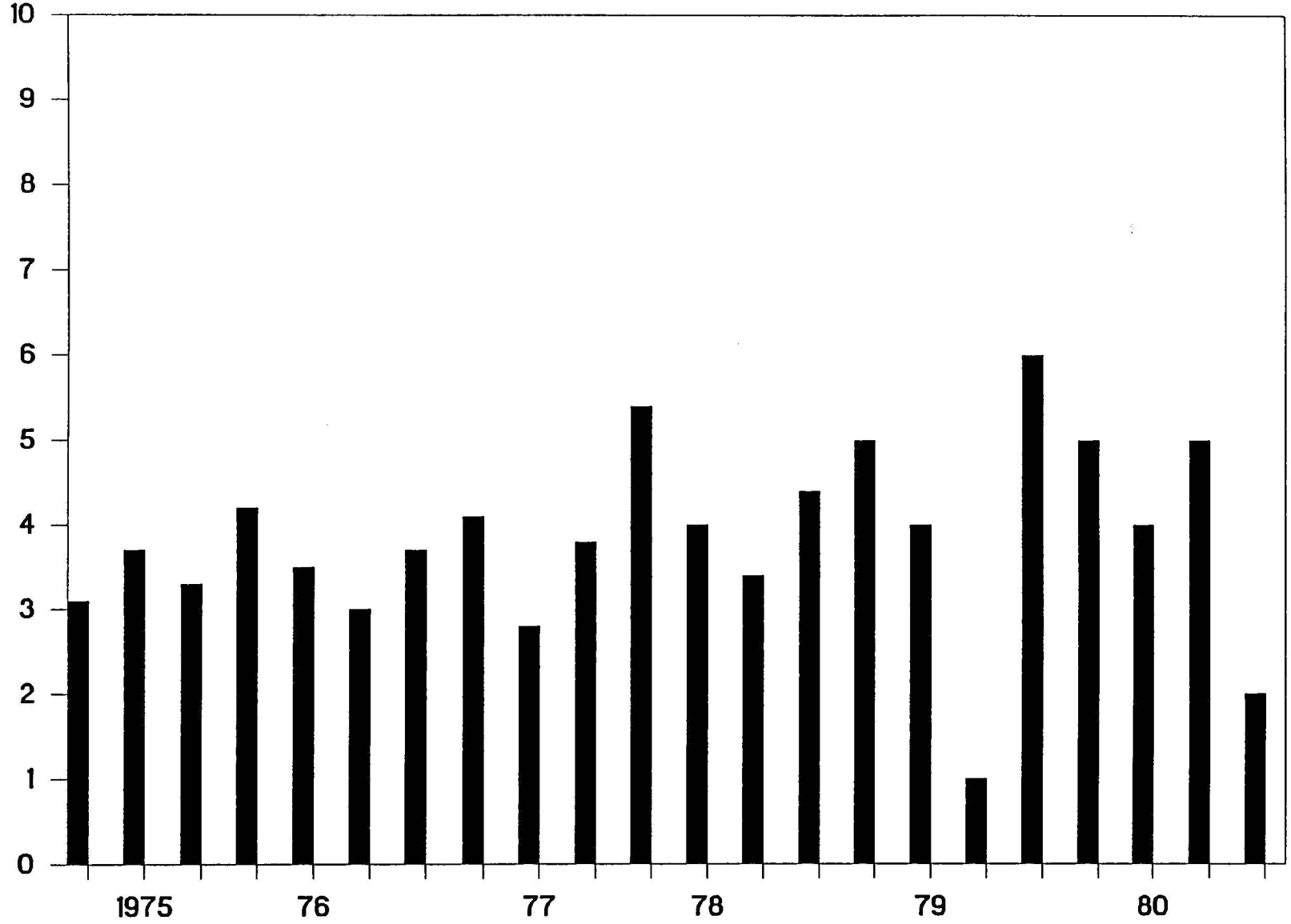

Figure 137. Graph of Potassium Versus Time For The Ozark Dam Site 1974-1981.

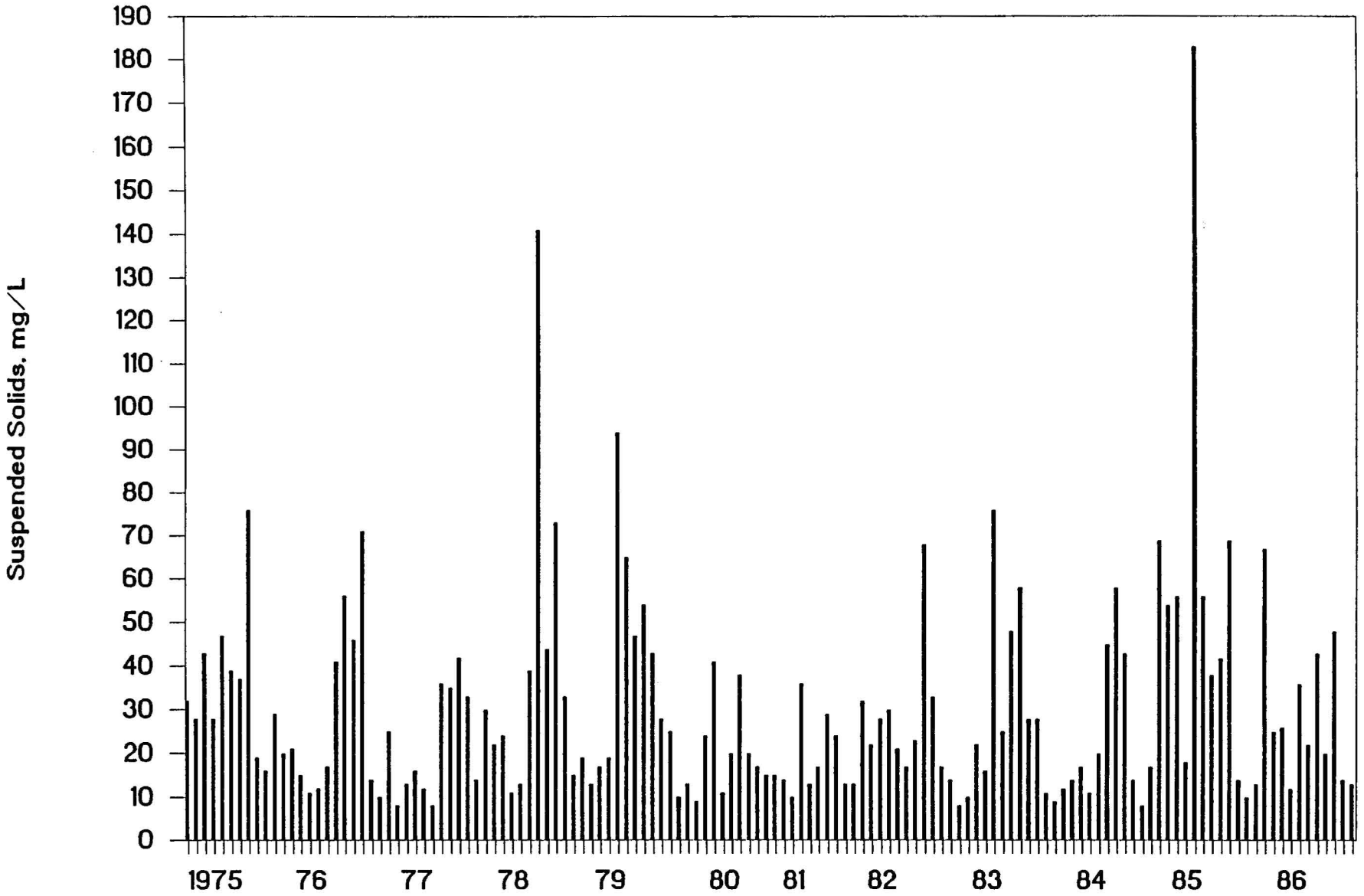

Figure 138. Graph of Suspended Solids Versus Time For The Ozark Dam Site 1975-1986.

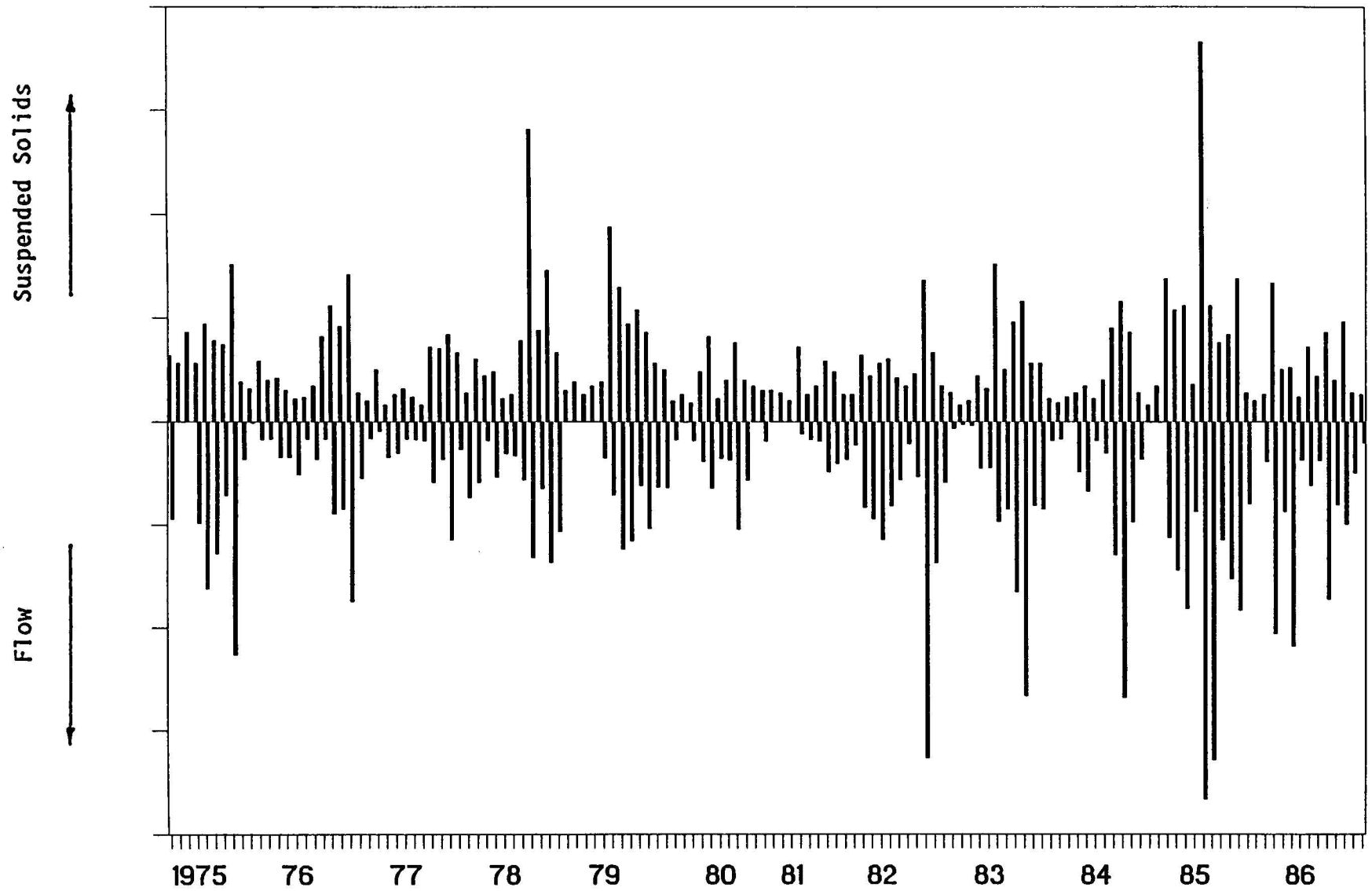

Figure 139. Graph of Suspended Solids And Flow Versus Time For The Ozark Dam Site 1975-1986.

Sulfate. Figure 140 shows the sulfate data at this site. The average concentration was 48 mg/L. The minimum and maximum concentrations were 6.3 and 110 mg/L, respectively. One hundred twenty-eight concentrations were included in the record. Both flow and sulfate are shown plotted as a function of time in Figure 141.

Total Hardness. The average total hardness concentration was 121 mg/L. The data are shown graphically in Figure 142. The minimum and maximum total hardness concentrations were 16 and 180 mg/L, respectively. The record included 69 concentrations. Figure 143 shows both total hardness and flow as a function of time.

Turbidity. The minimum and maximum turbidity values were 6 and 180 turbidity units, respectively. The average value was 34 turbidity units. Sixty-three values were included in the record. The data are shown in Figure 144. The period of record included the years from 1980 until 1986. Both flow and turbidity are shown graphically as a function of time in Figure 145. As would be expected, the turbidity values tended to be greater at the larger flow rates and smaller at lower flow rates.

Dardanelle

The Dardanelle sampling site is near the left bank on the upstream side of the bridge on State Highway 7 at Dardanelle. It is 1.0 mile upstream from Whig Creek, 2.0 miles downstream from Dardanelle Dam and 4.7 miles downstream from the Illinois Bayou. It is located at mile 219.5.

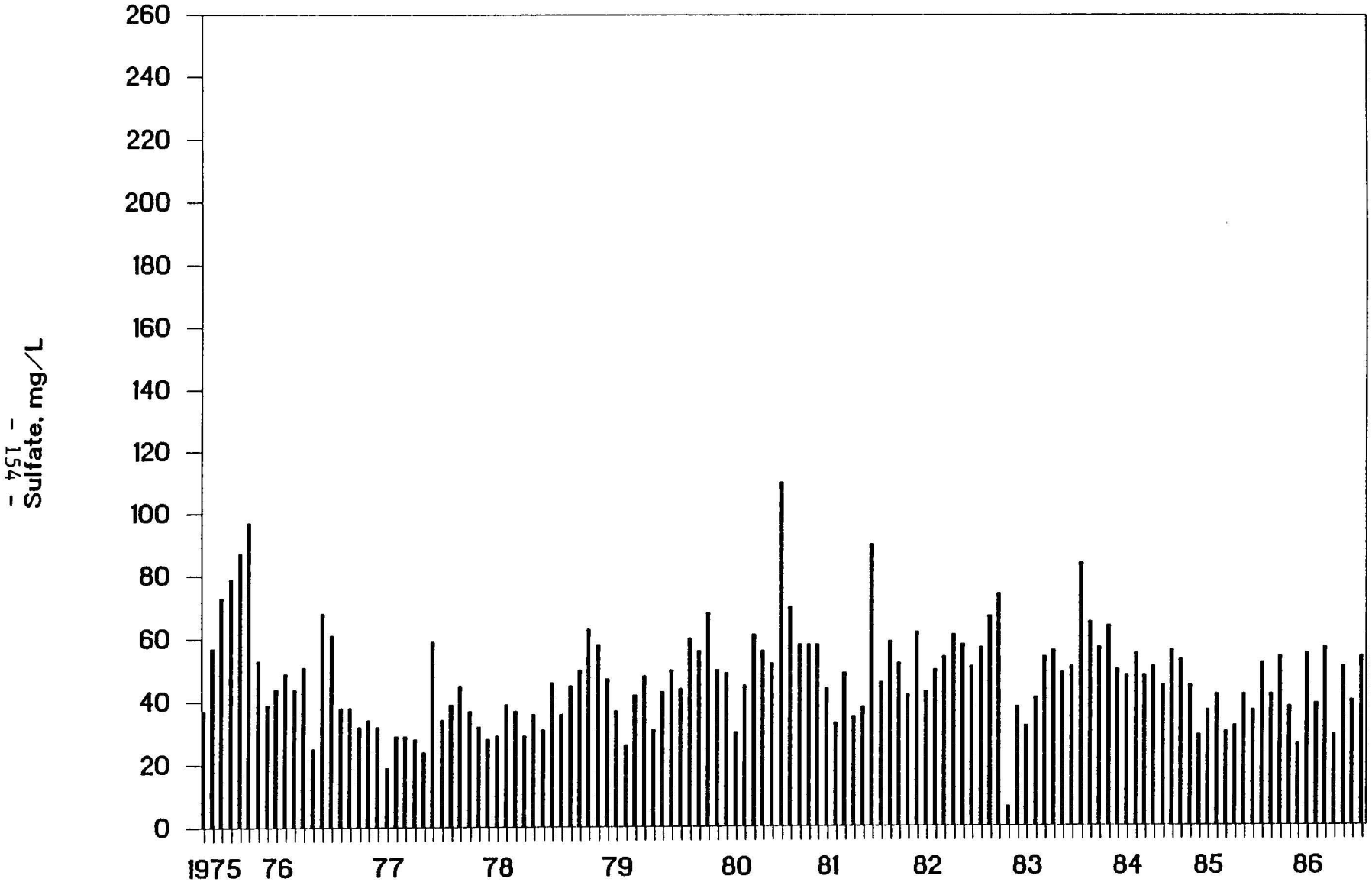

Figure 140. Graph of Sulfate Versus Time For The Ozark Dam Site 1975-1986.

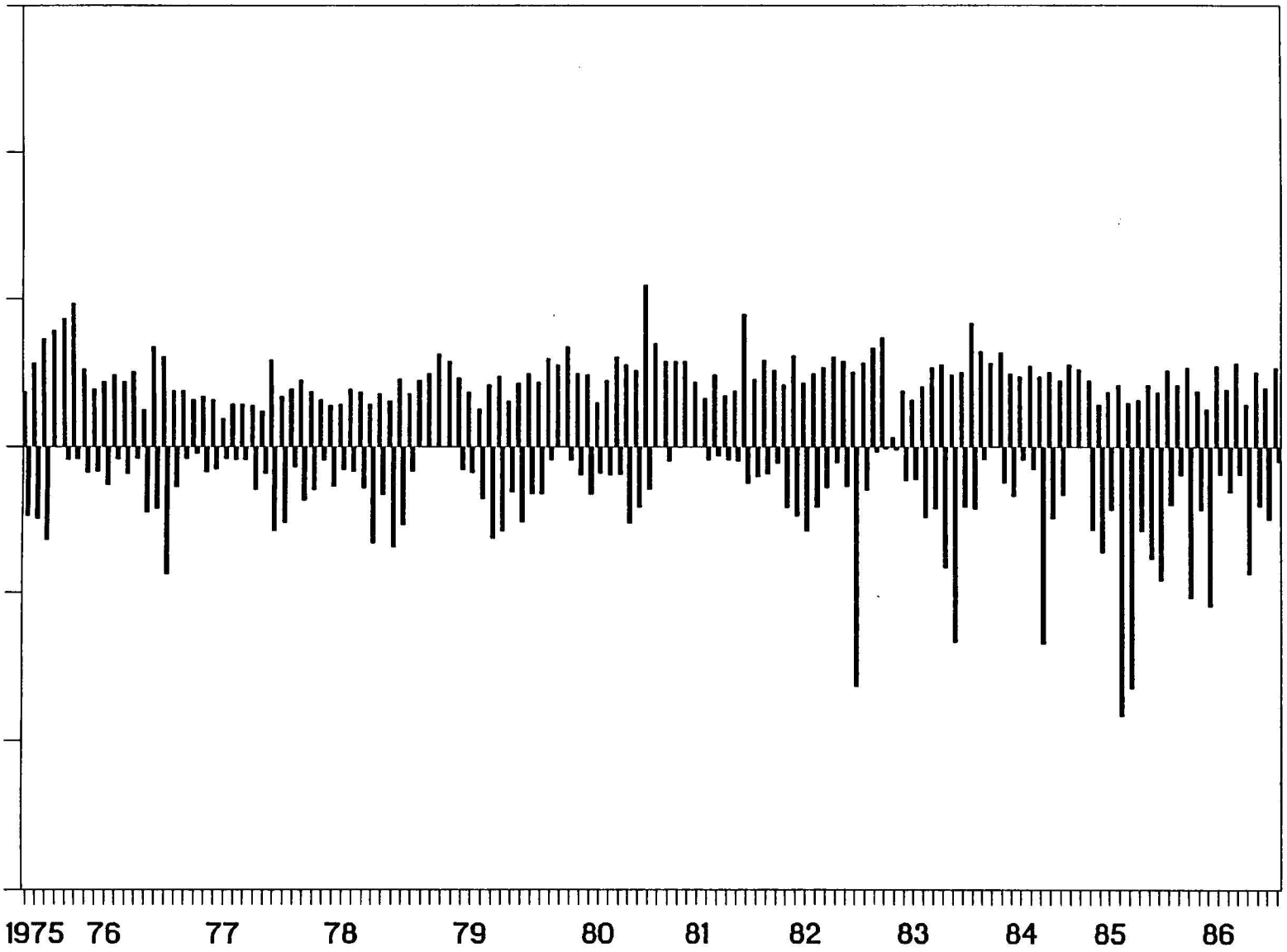

Figure 141. Graph of Sulfate And Flow Versus Time For The Ozark Dam Site 1975-1986.

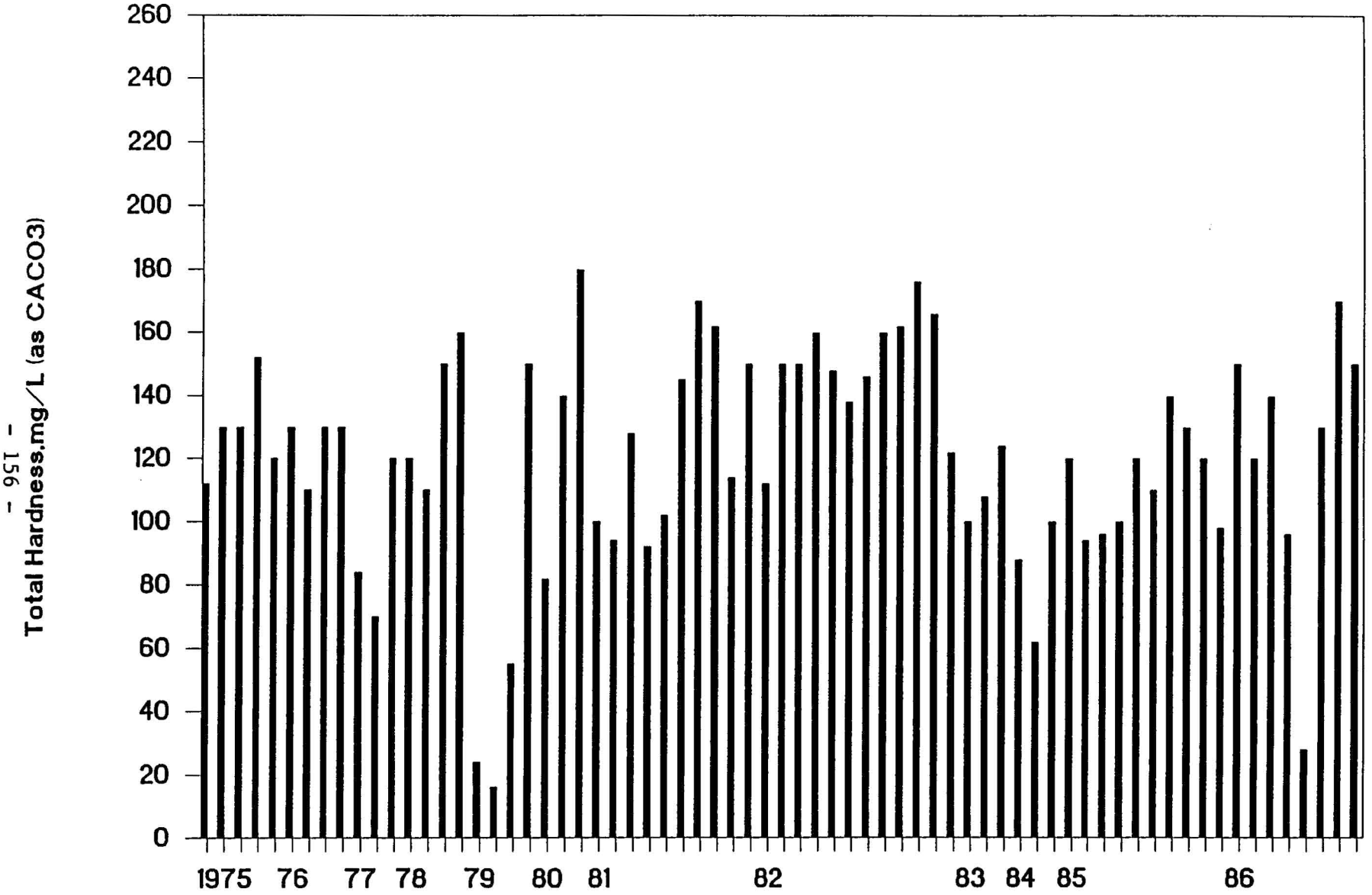

Figure 142. Graph of Total Hardness Versus Time For The Ozark Dam Site 1975-1986.

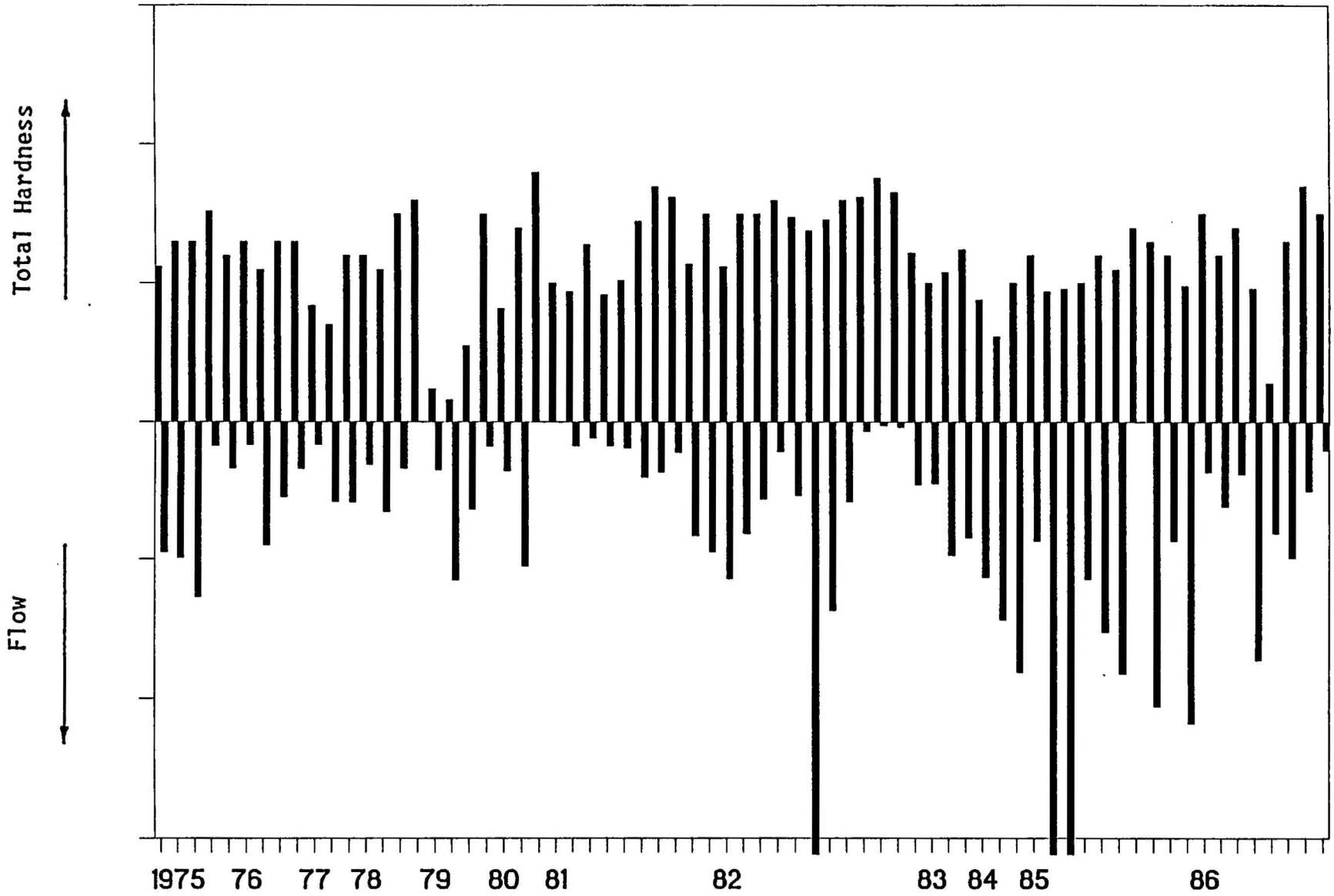

Figure 143. Graph of Total Hardness And Flow Versus Time For The Ozark Dam Site 1975-1986.

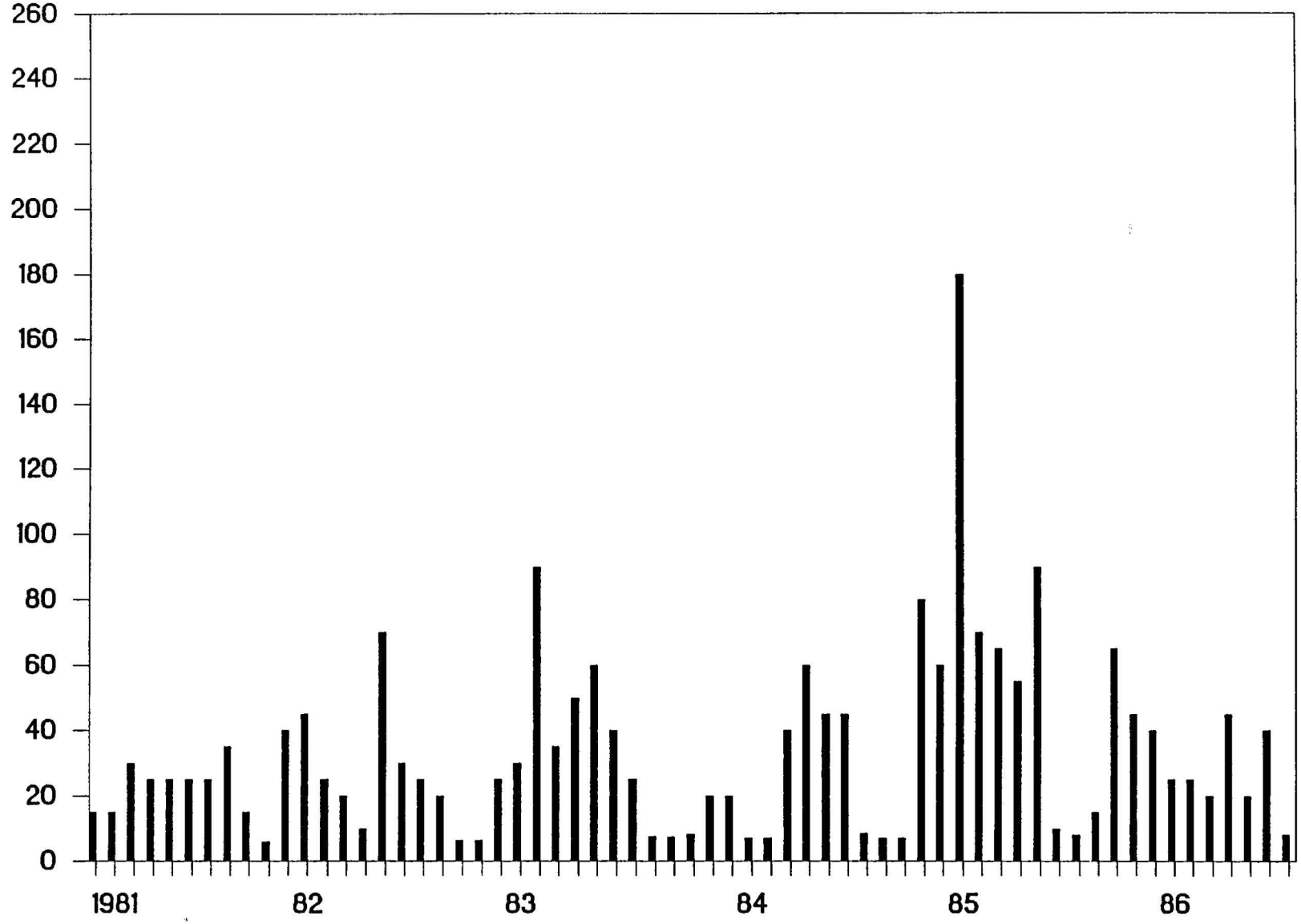

Figure 144. Graph of Turbidity Versus Time For The Ozark Dam Site 1980-1986.

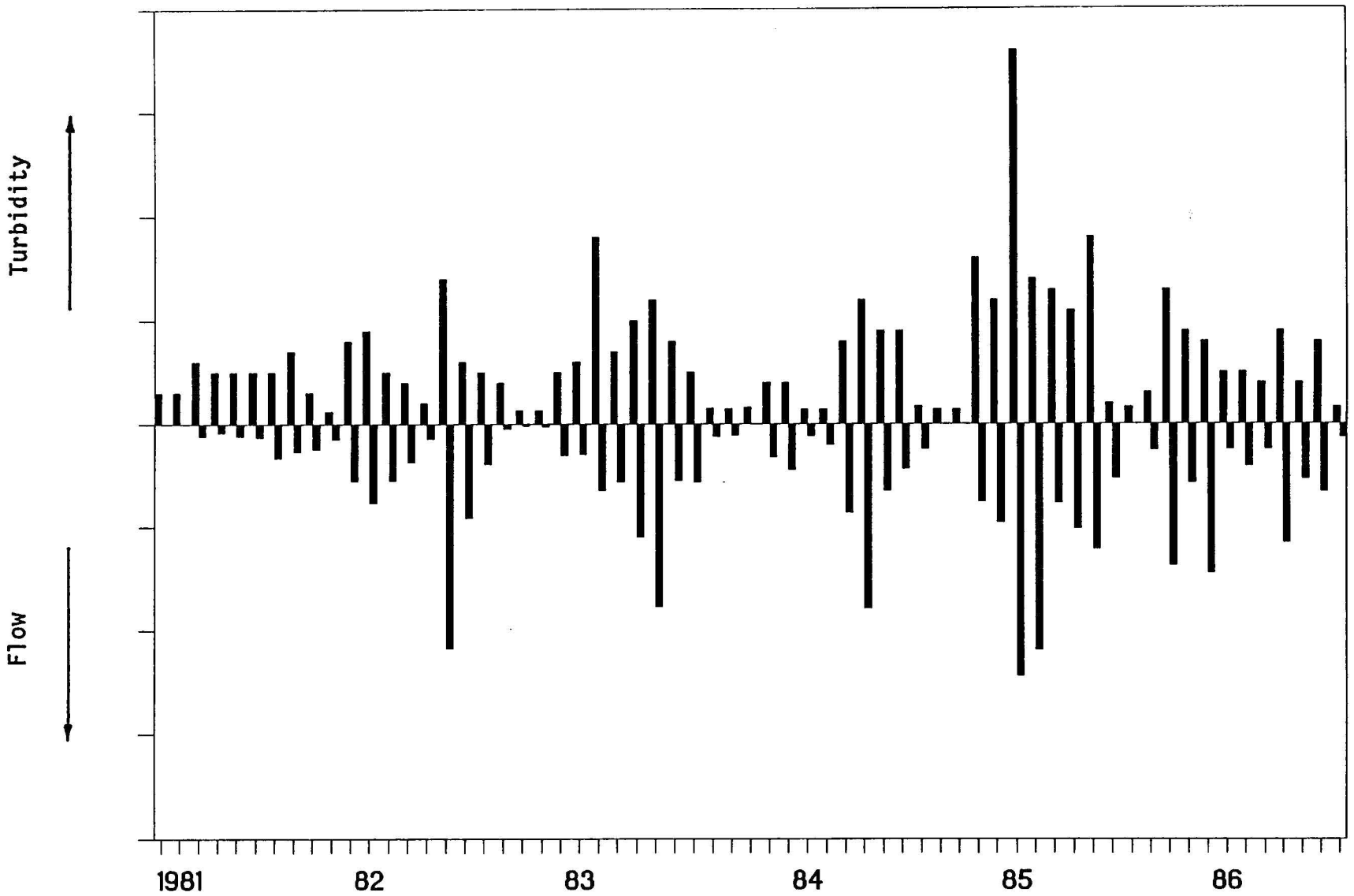

Figure 145. Graph of Turbidity And Flow Versus Time For The Ozark Dam Site 1980-1986.

Alkalinity. The average alkalinity concentration at this site was 95 mg/L. The concentrations ranged from 26 to 198 mg/L for the 1,037 values reported. The data are shown for short-term periods in Figures 146 through 151. Figure 152 shows all data from 1948 until 1963. The average alkalinity concentration from 1948 until 1963 was 95 mg/L. The minimum and maximum concentrations were 26 and 198 mg/L, respectively. The average concentration after 1974 was 87 mg/L. The minimum and maximum concentrations after 1974 were 63 and 120 mg/L, respectively. The period of record was from 1948 until 1963. Figures 153 through 158 show both alkalinity and flow plotted versus time for the Dardanelle site.

Calcium. The calcium data are shown for short-term periods in Figures 159 through 164 for the Dardanelle site. Figure 165 shows all data from 1948 until 1963. Flow and calcium concentrations are plotted versus time in Figures 166 through 171.

Chloride. The chloride data are shown in Figures 172 through 178. Figure 179 shows all chloride data from 1948 until 1963. The minimum and maximum concentrations were 14 and 1,680 mg/L, respectively. The average concentration was 264 mg/L for the 129 concentrations reported from 1948 until 1963. The average concentration from 1975 until 1986 was 106 mg/L. The minimum and maximum concentrations from 1948 until 1963 were 14 and 1,680 mg/L, respectively. The equivalent values for the period of record from 1975 until 1986 were 15 and 340 mg/L, respectively. Figures 180 through 186 show both chloride and flow plotted as a function of time.

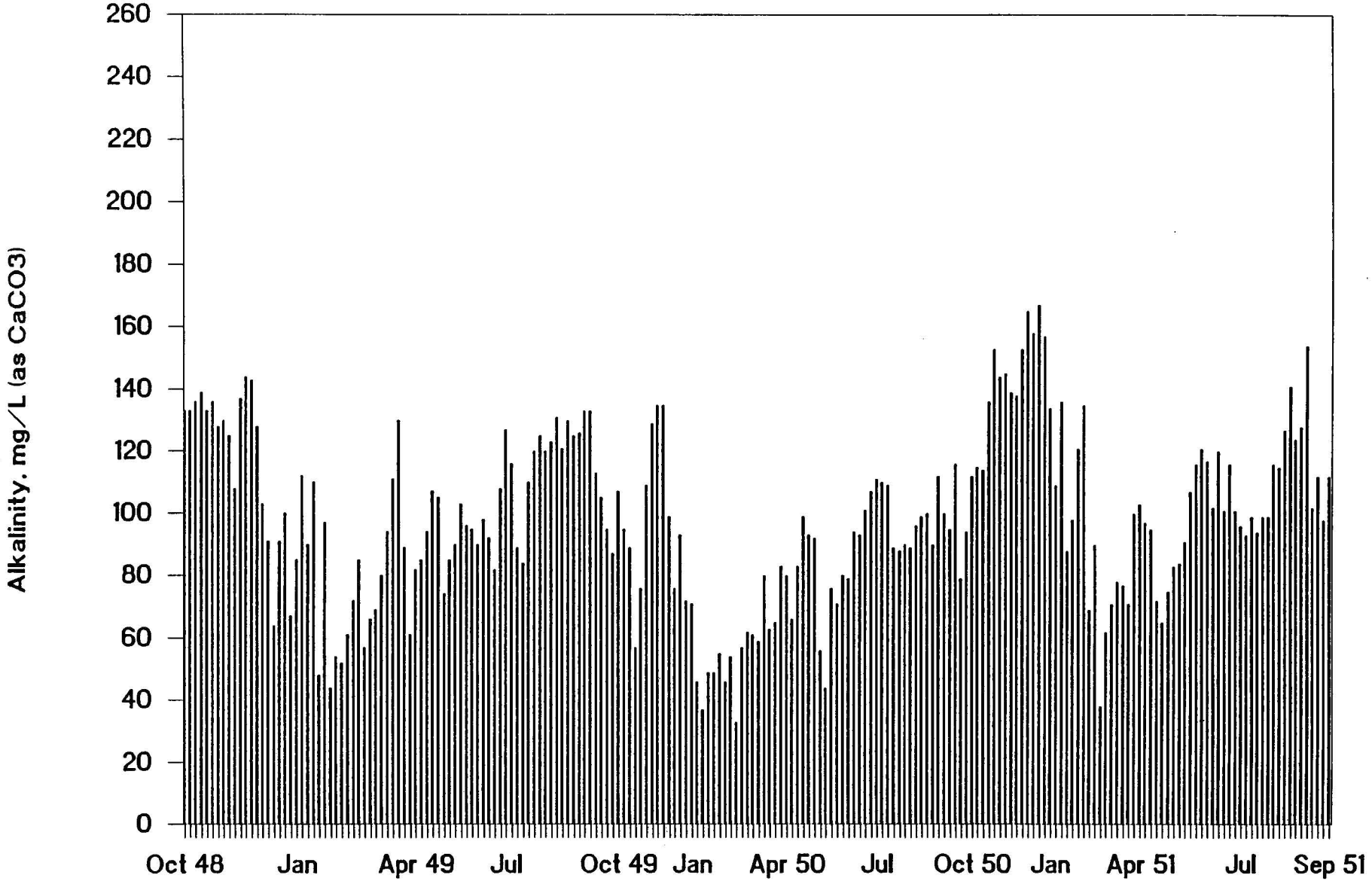

Figure 146. Graph of Alkalinity Versus Time For The Dardanelle Site 1948-1951.

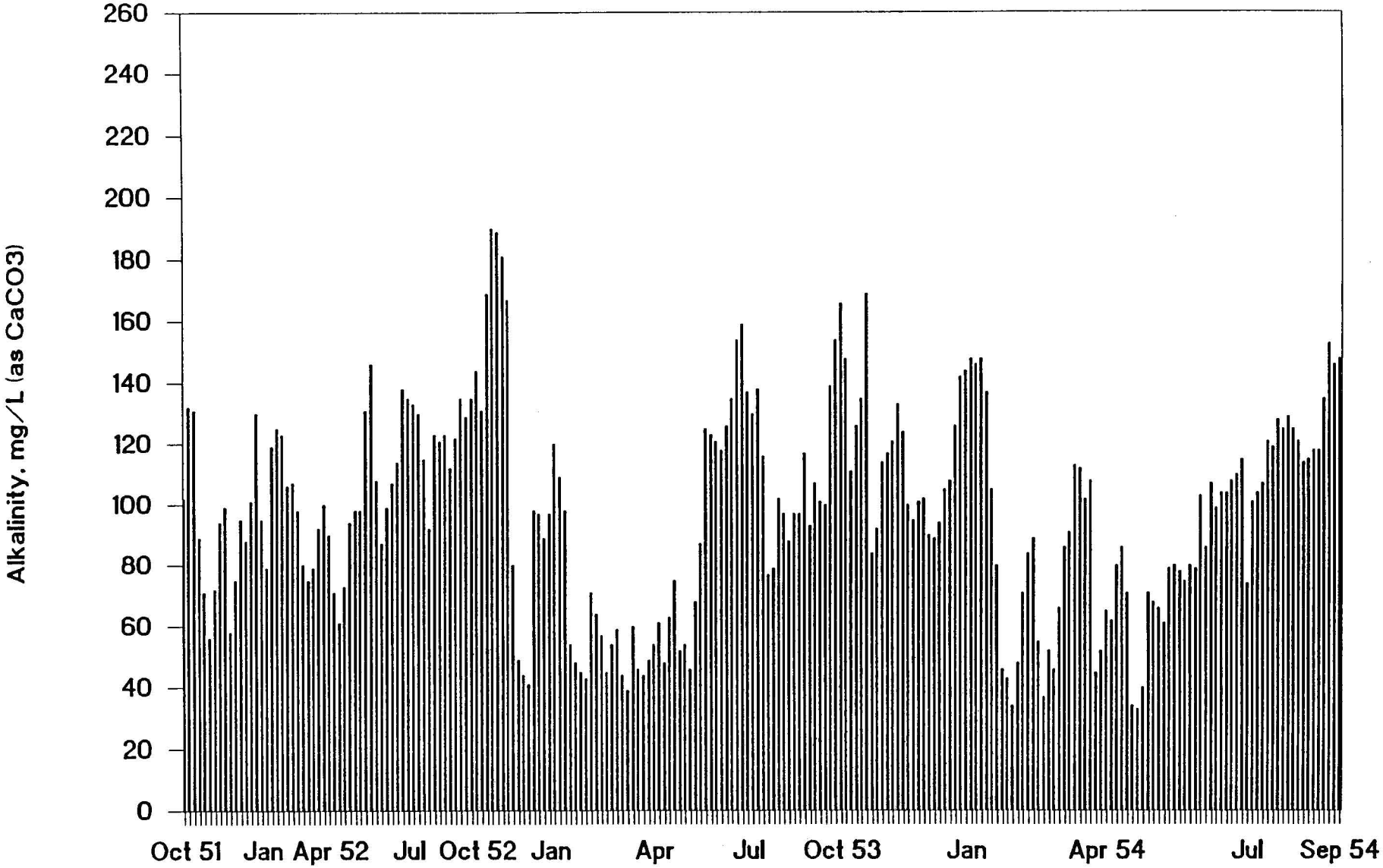

Figure 147. Graph of Alkalinity Versus Time For The Dardanelle Site 1951-1954.

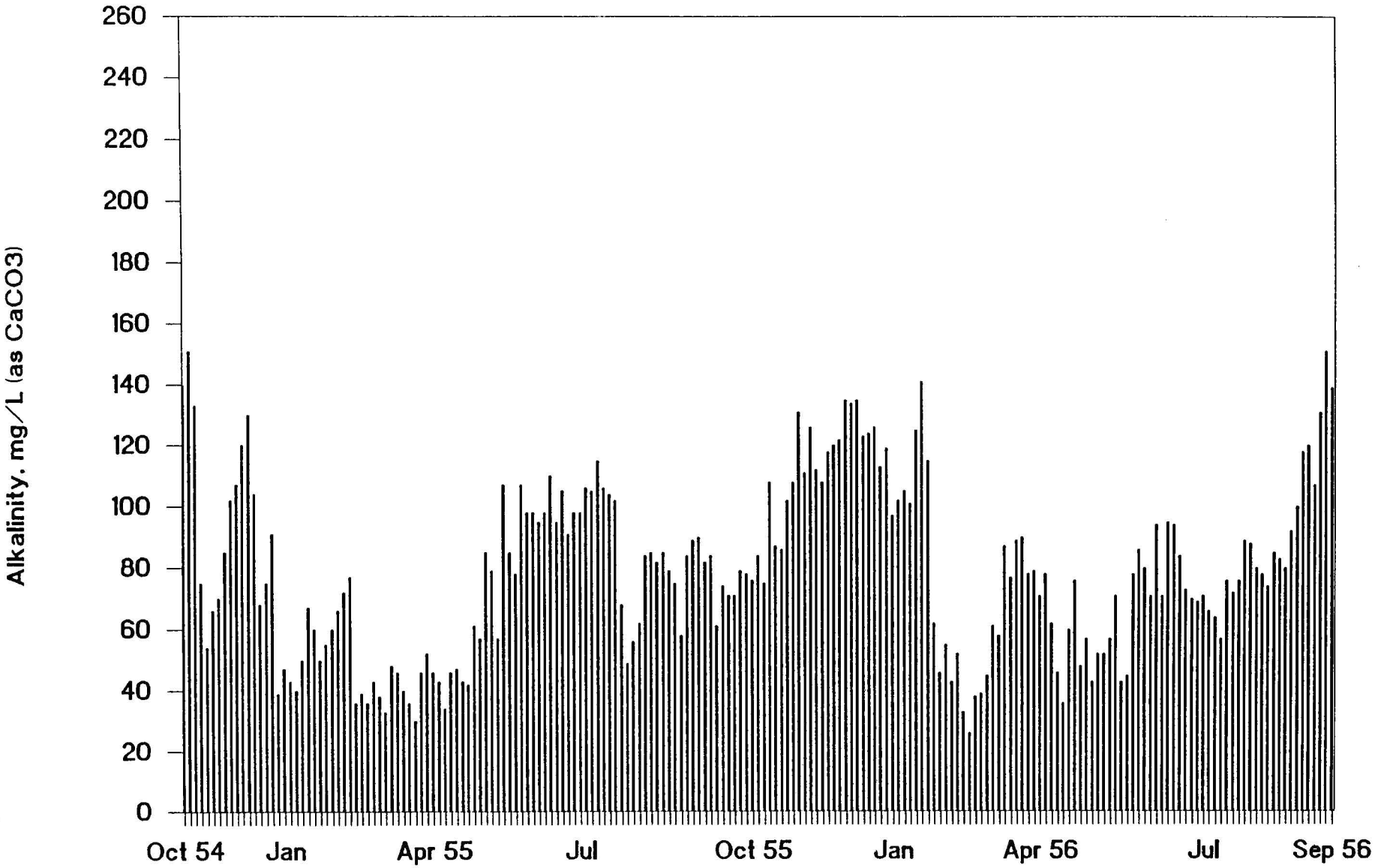

Figure 148. Graph of Alkalinity Versus Time For The Dardanelle Site 1954-1956.

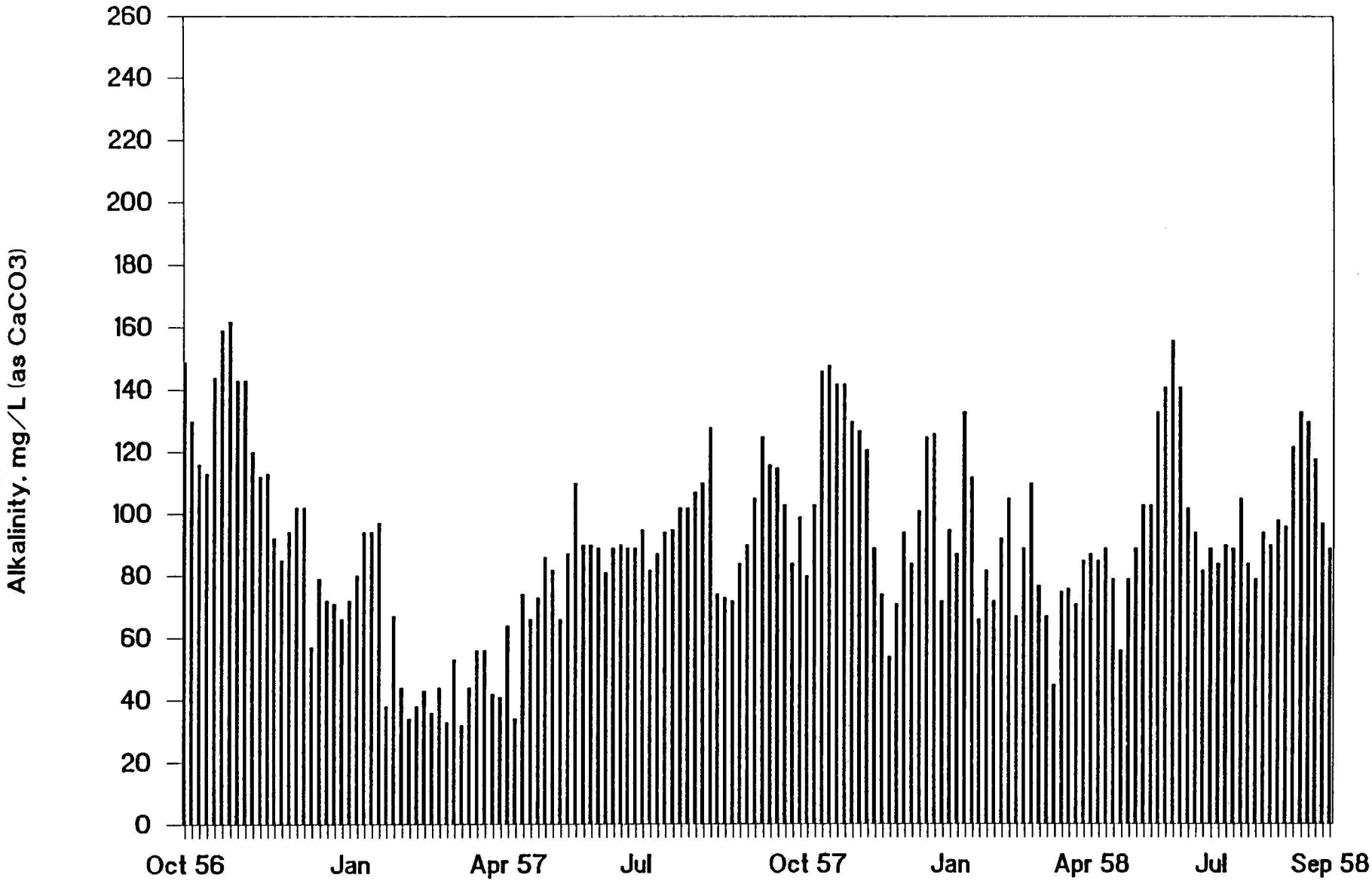

Figure 149. Graph of Alkalinity Versus Time For The Dardanelle Site 1956-1958.

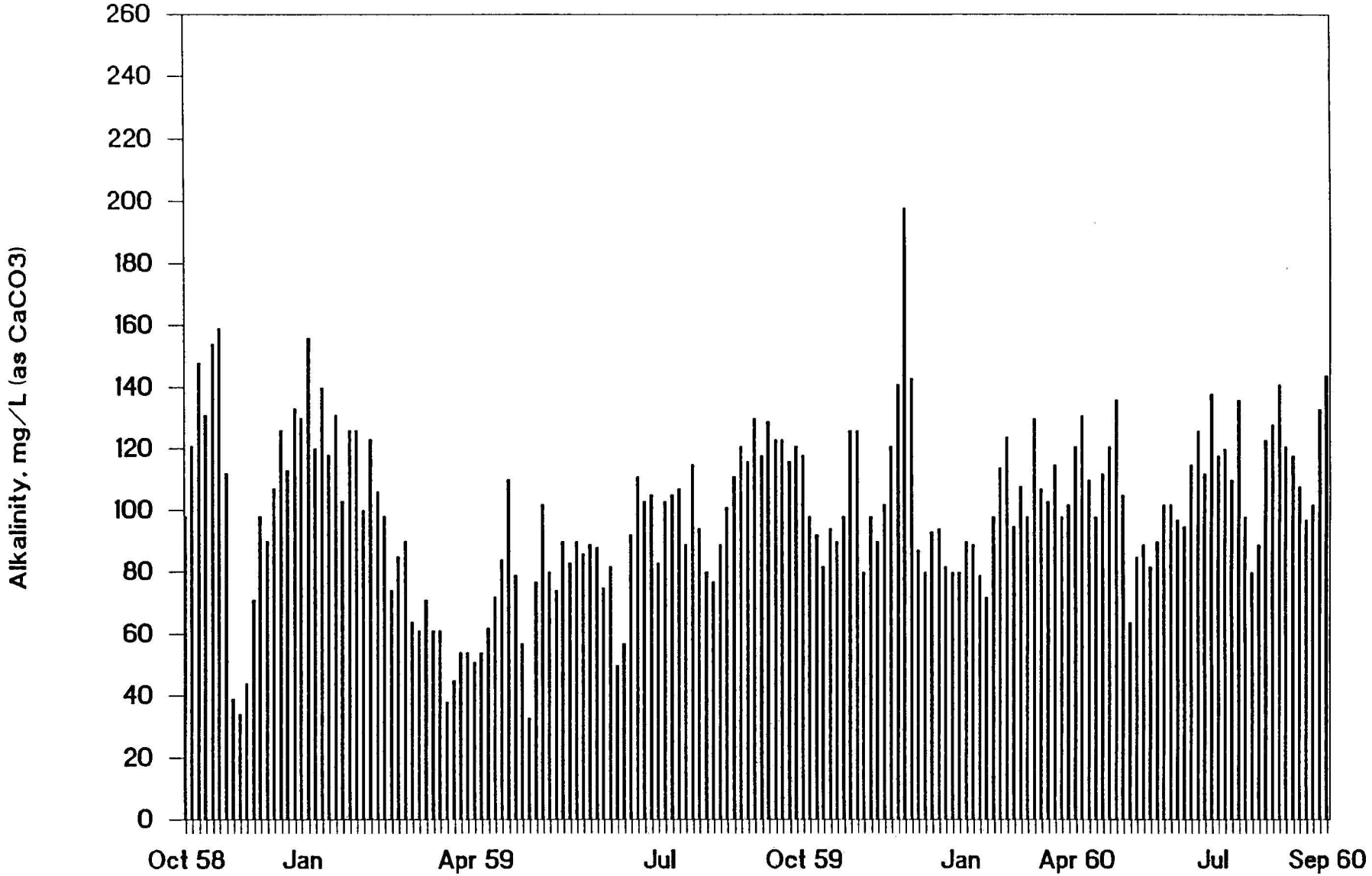

Figure 150. Graph of Alkalinity Versus Time For The Dardanelle Site 1958-1960.

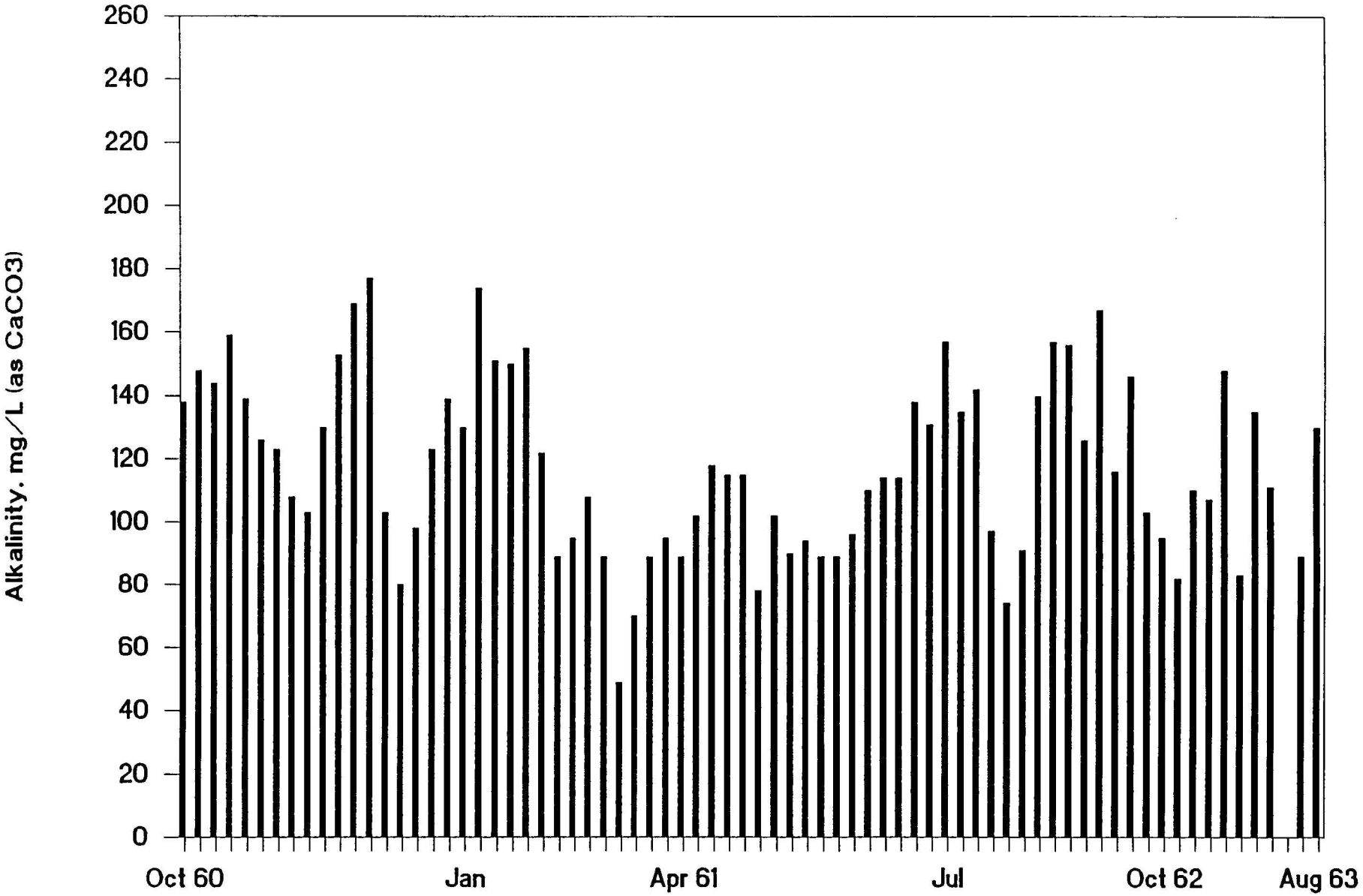

Figure 151. Graph of Alkalinity Versus Time For The Dardanelle Site 1960-1963.

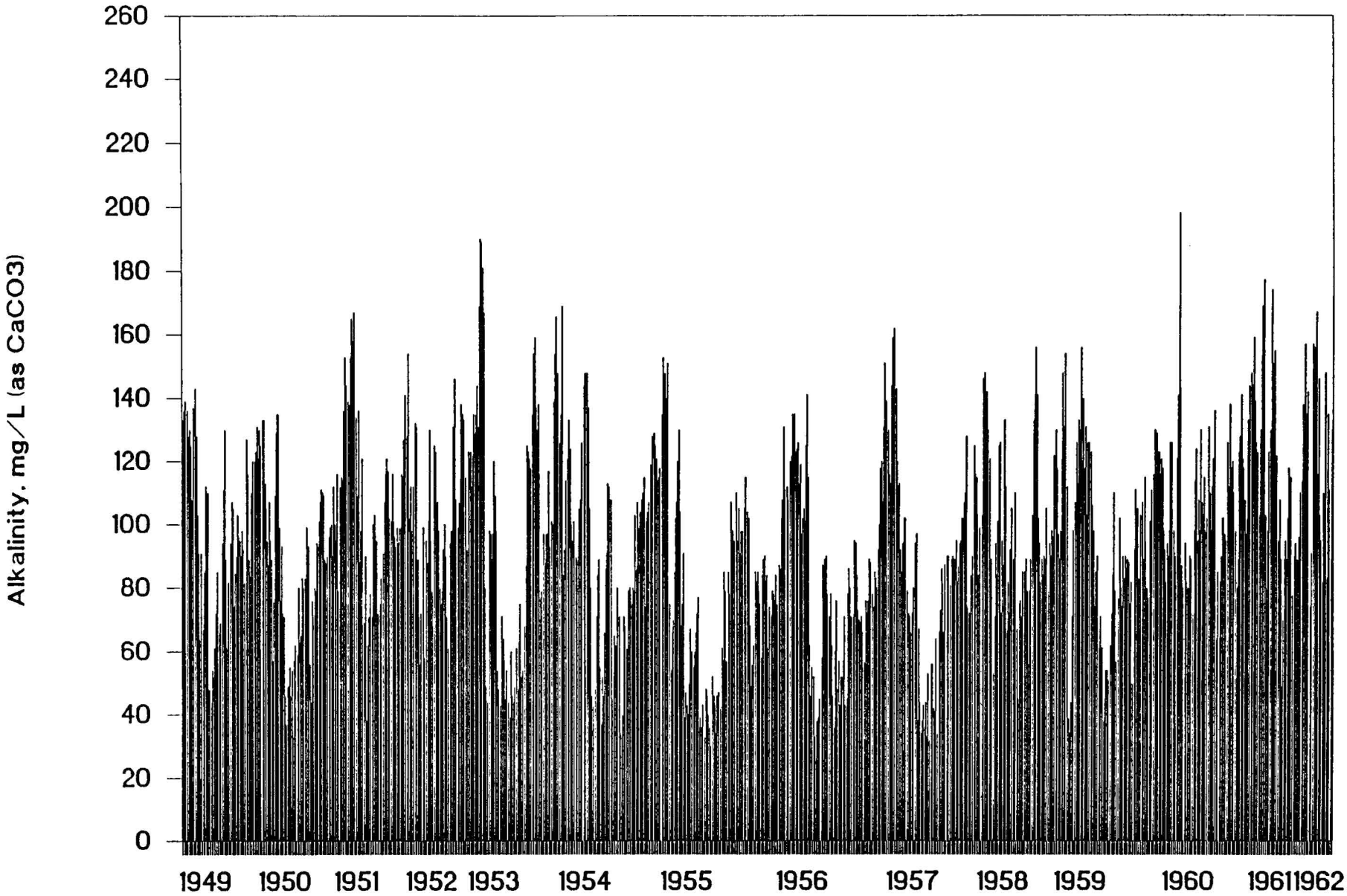

Figure 152. Graph of Alkalinity Versus Time For The Dardanelle Site 1948-1963.

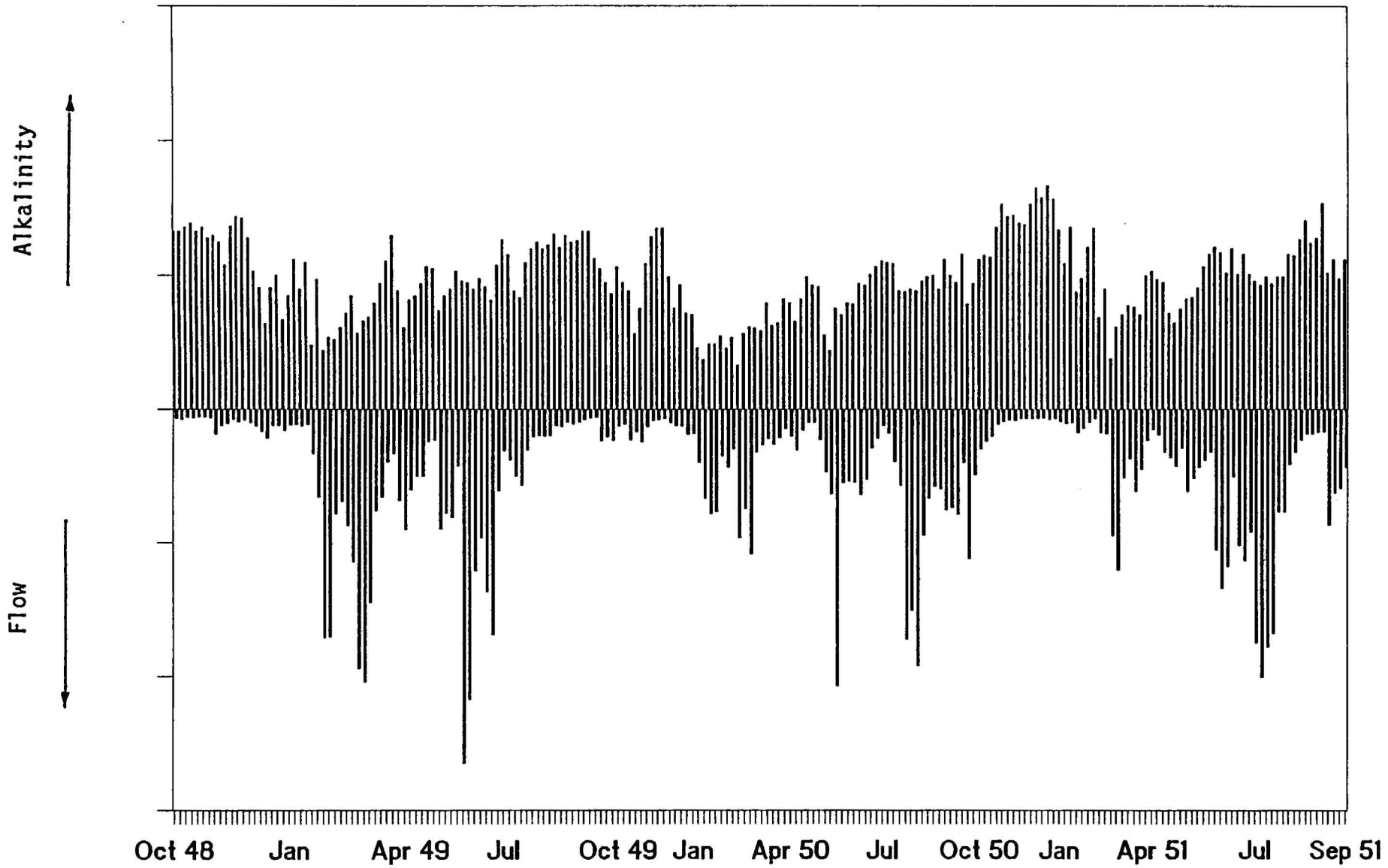

Figure 153. Graph of Alkalinity And Flow Versus Time For The Dardanelle Site 1948-1951.

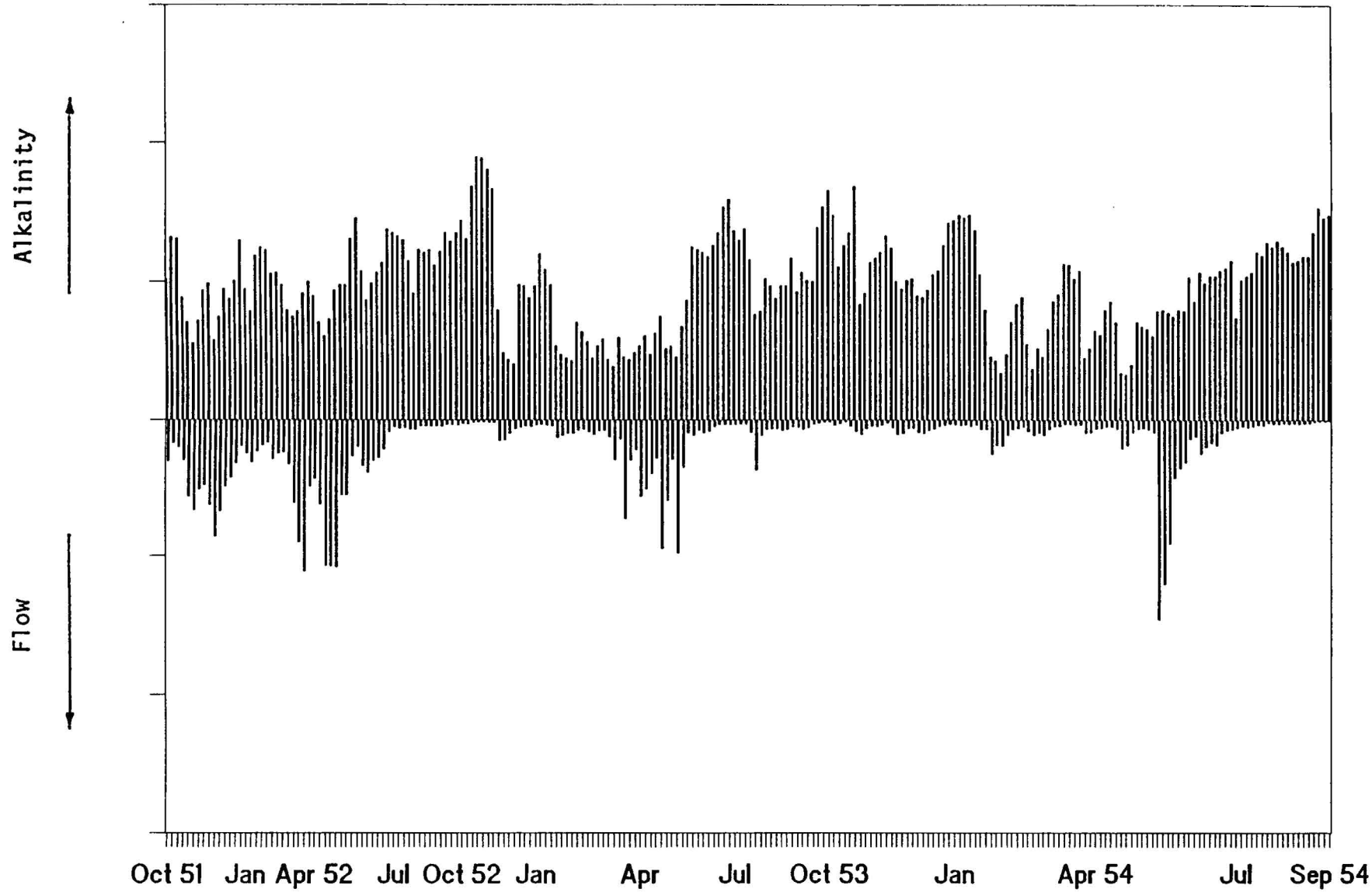

Figure 154. Graph of Alkalinity And Flow Versus Time For The Dardanelle Site 1951-1954.

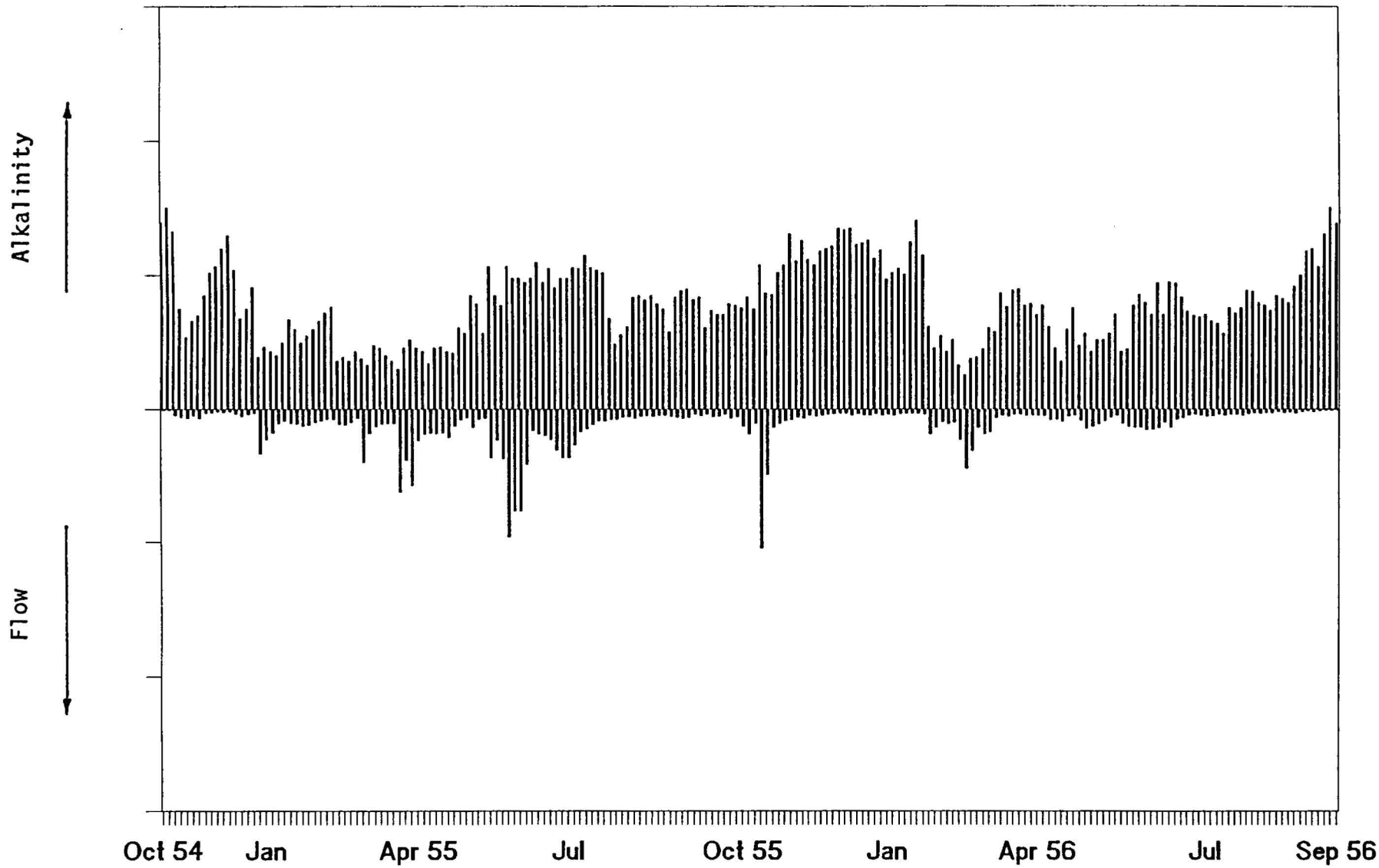

Figure 155. Graph of Alkalinity And Flow Versus Time For The Dardanelle Site 1954-1956.

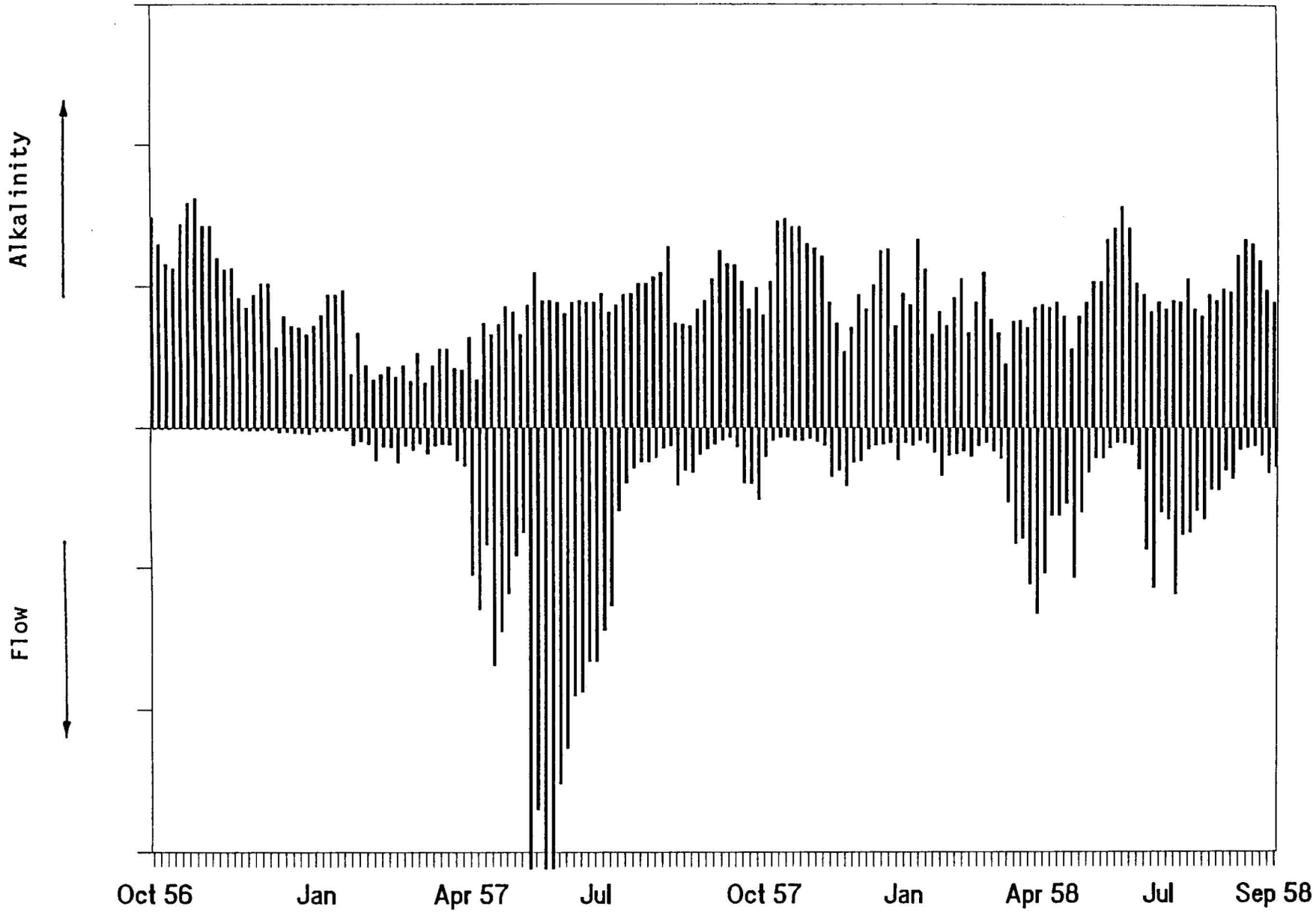

Figure 156. Graph of Alkalinity And Flow Versus Time For The Dardanelle Site 1956-1958.

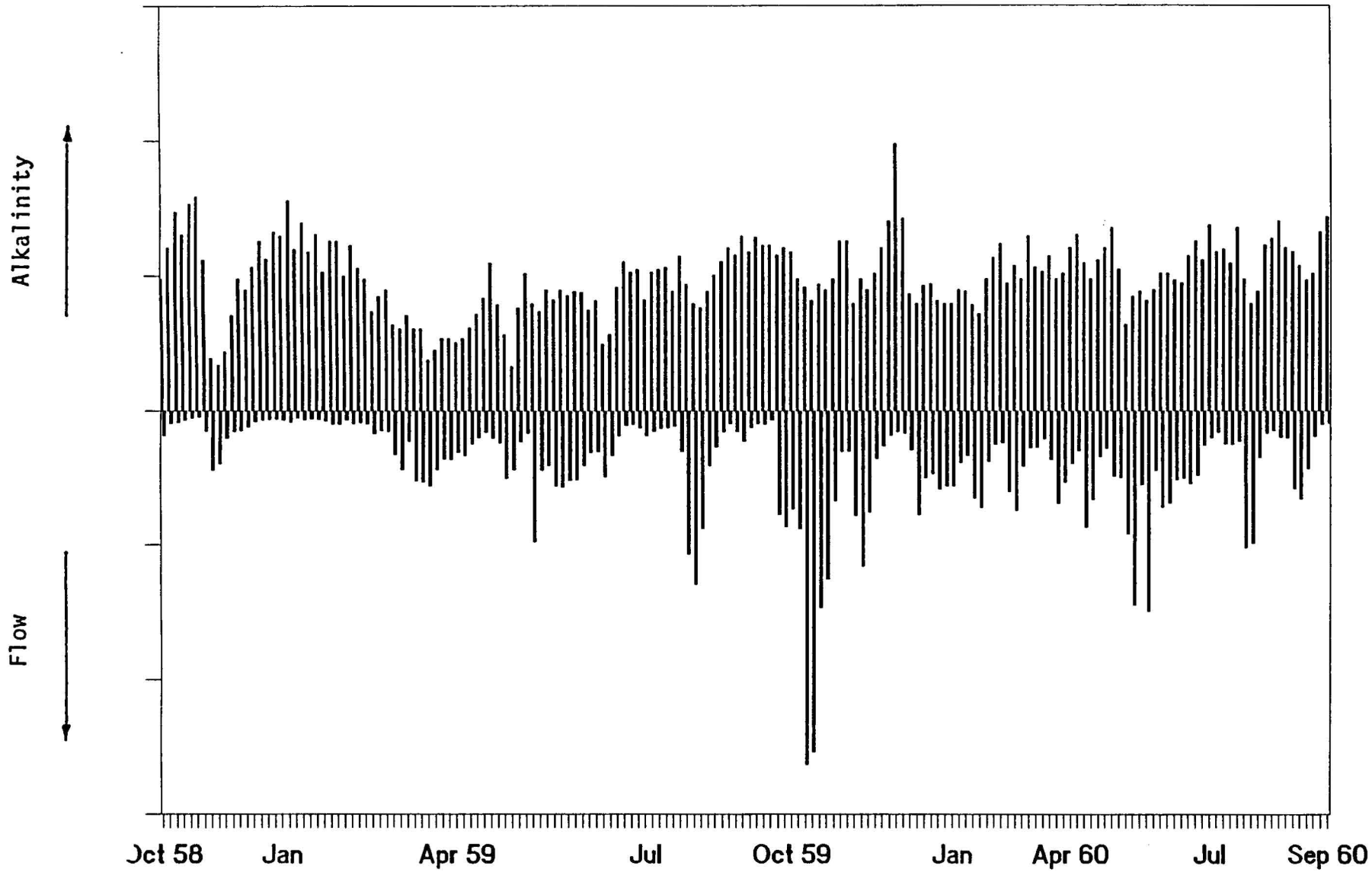

Figure 157. Graph of Alkalinity And Flow Versus Time For The Dardanelle Site 1958-1960.

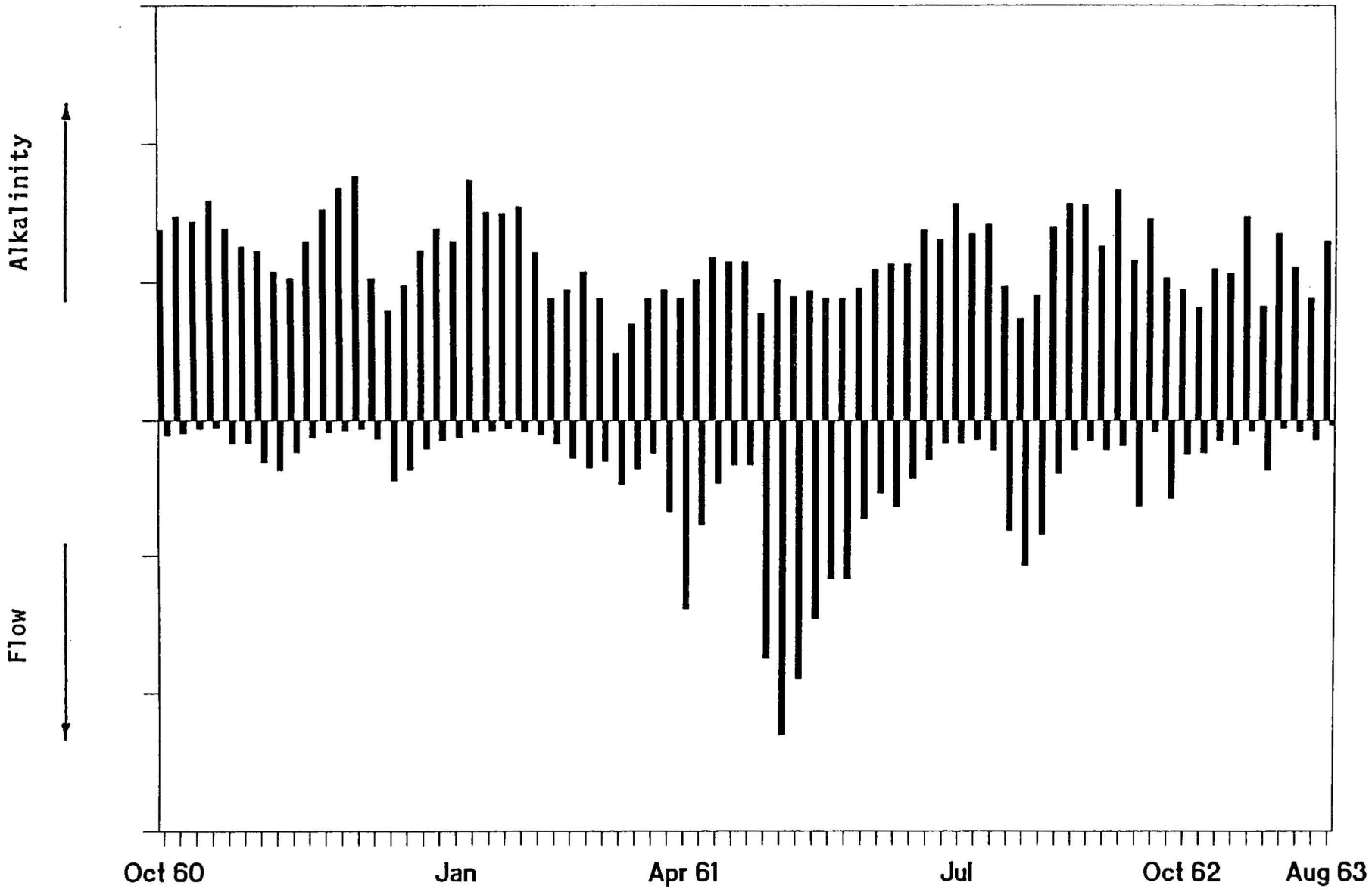

Figure 158. Graph of Alkalinity And Flow Versus Time For The Dardanelle Site 1960-1963.

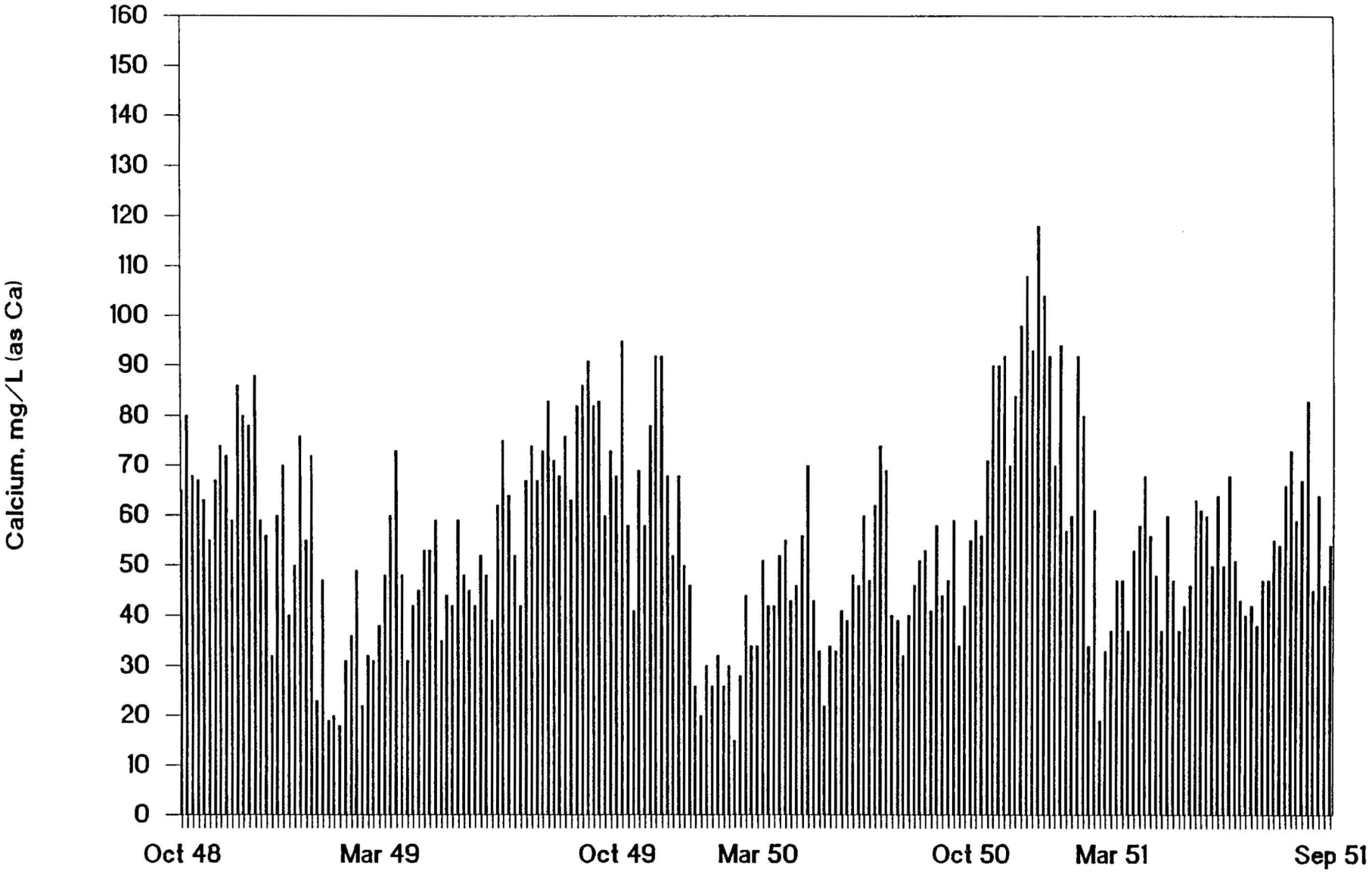

Figure 159. Graph of Calcium Versus Time For The Dardanelle Site 1948-1951.

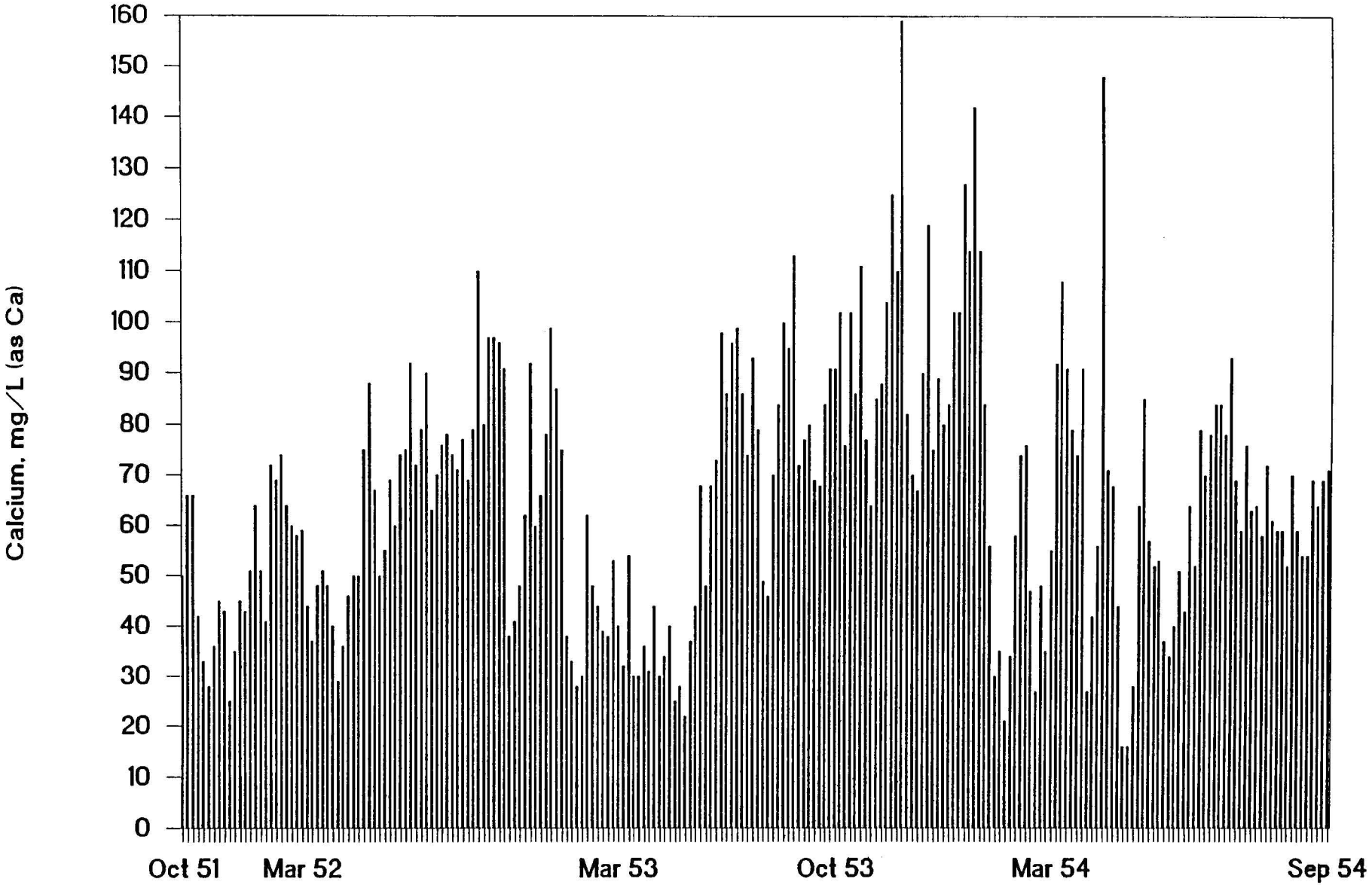

Figure 160. Graph of Calcium Versus Time For The Dardanelle Site 1951-1954.

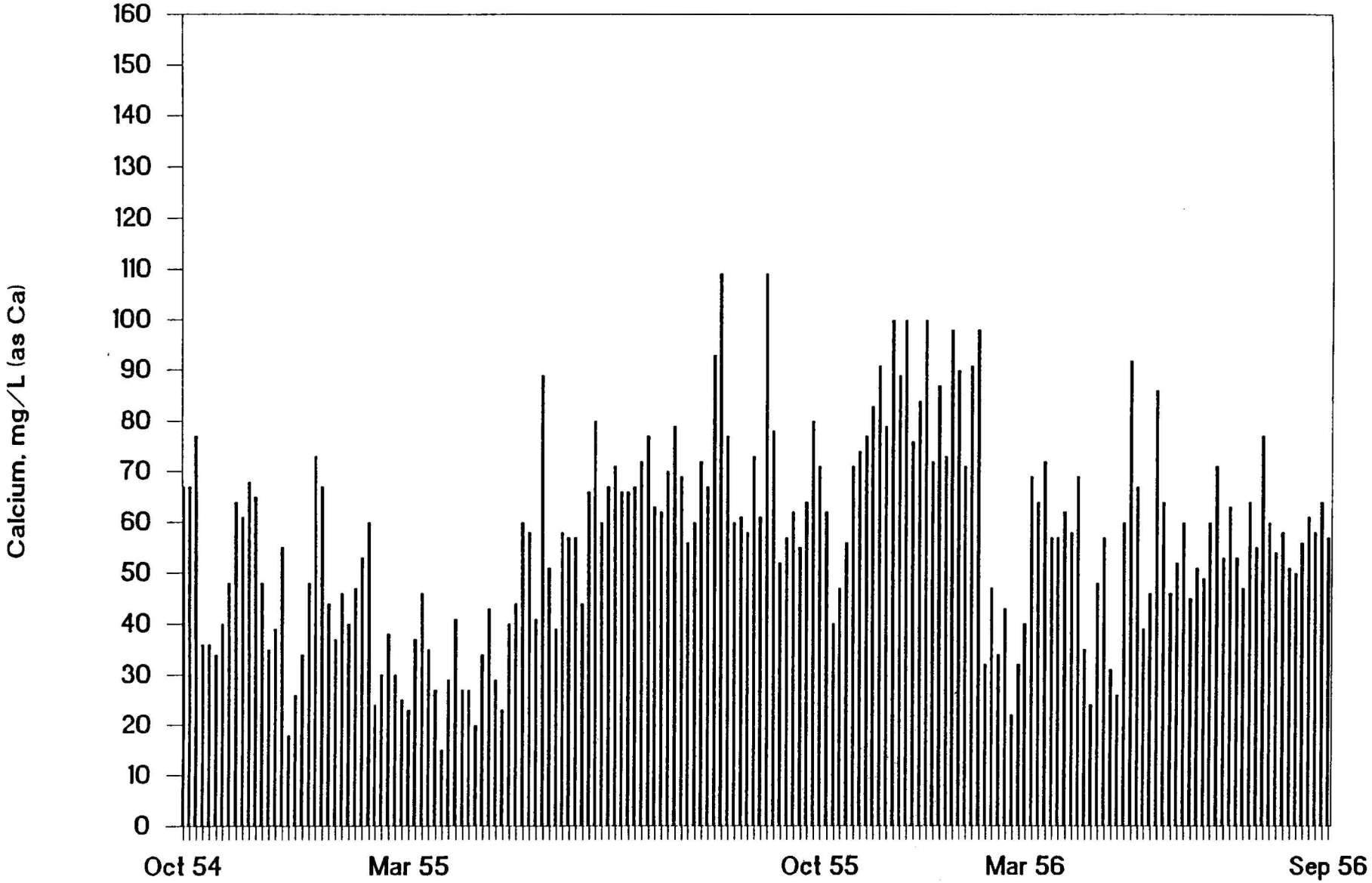

Figure 161. Graph of Calcium Versus Time For The Dardanelle Site 1954-1956.

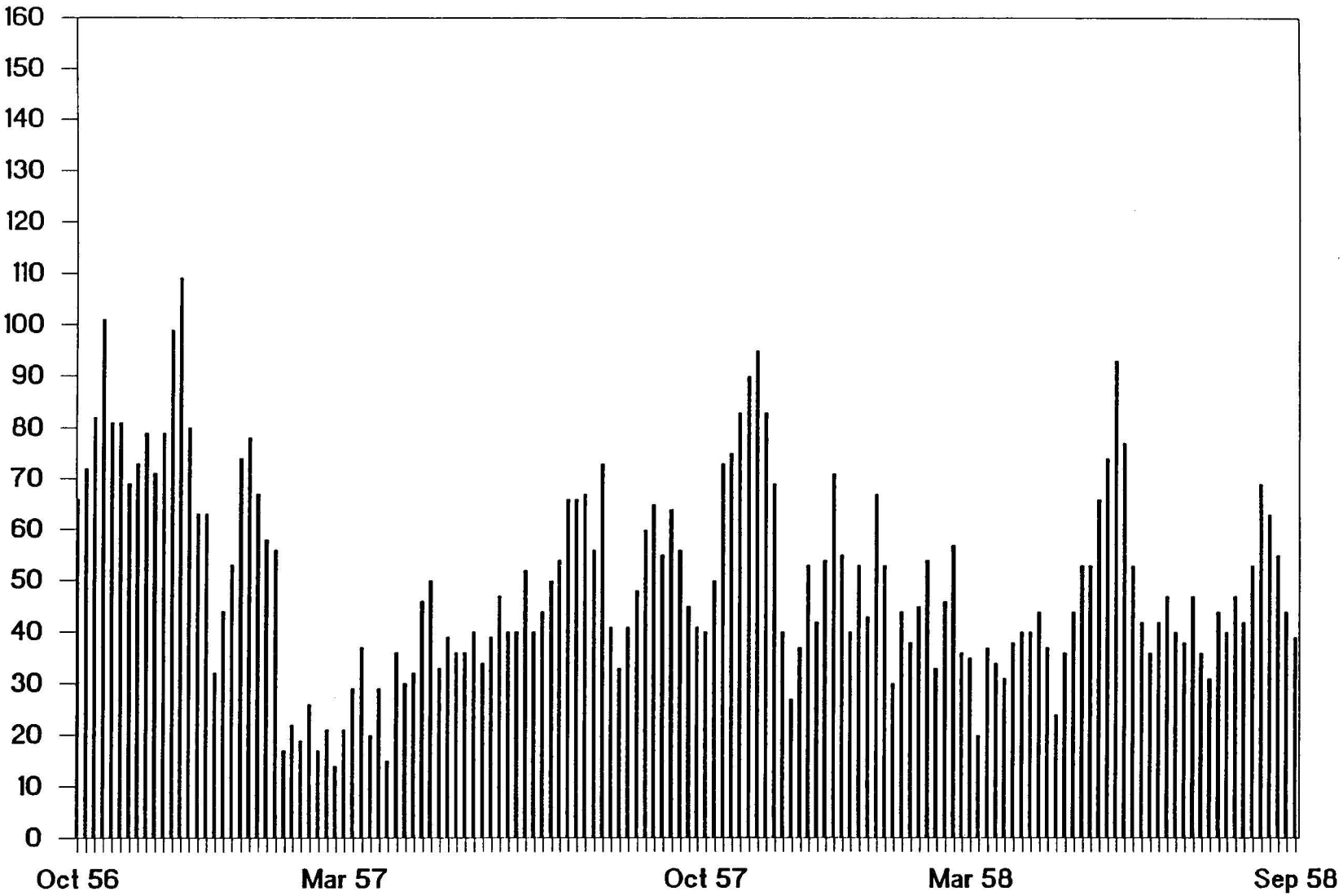

Figure 162. Graph of Calcium Versus Time For The Dardanelle Site 1956-1958.

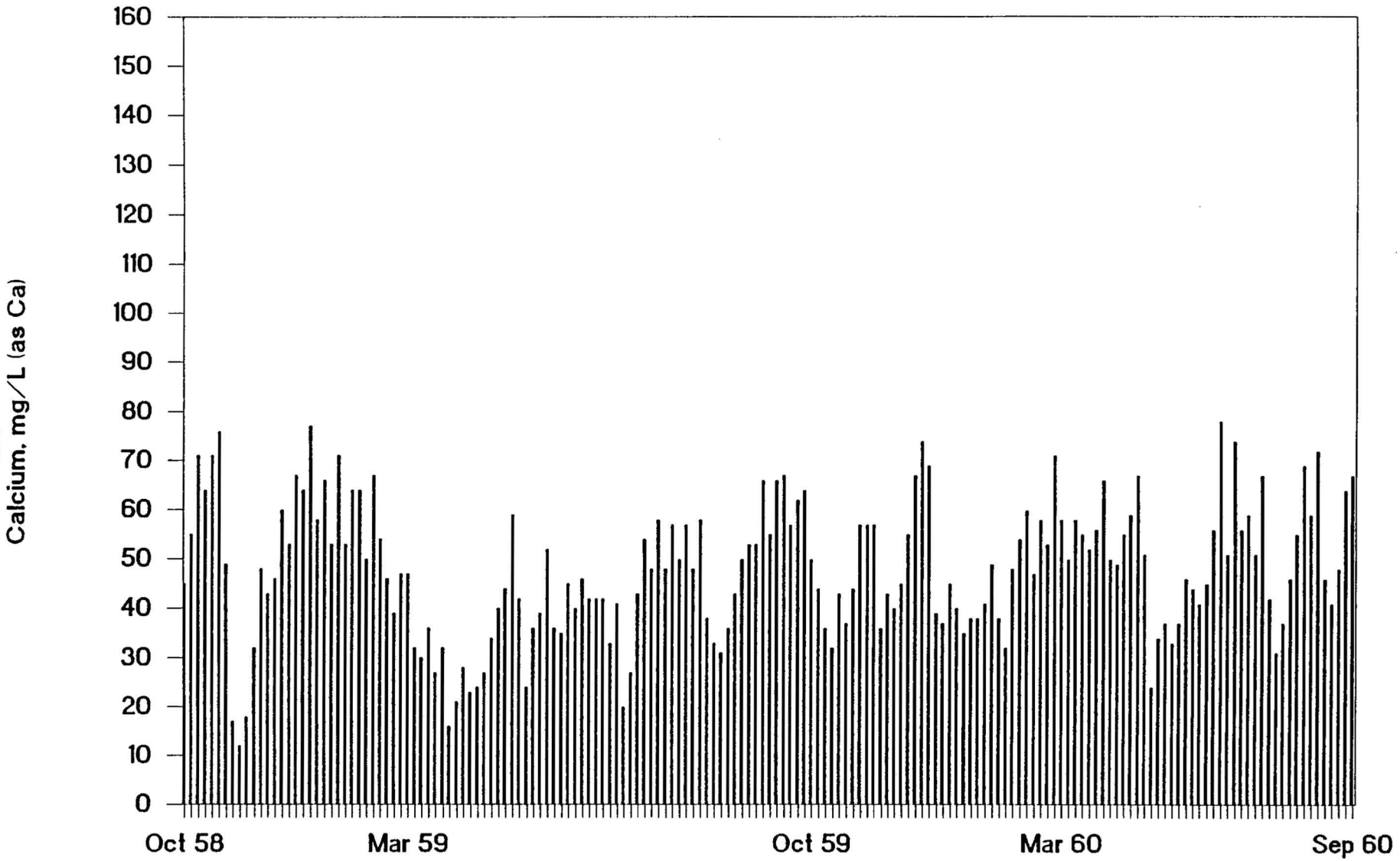

Figure 163. Graph of Calcium Versus Time For The Dardanelle Site 1958-1960.

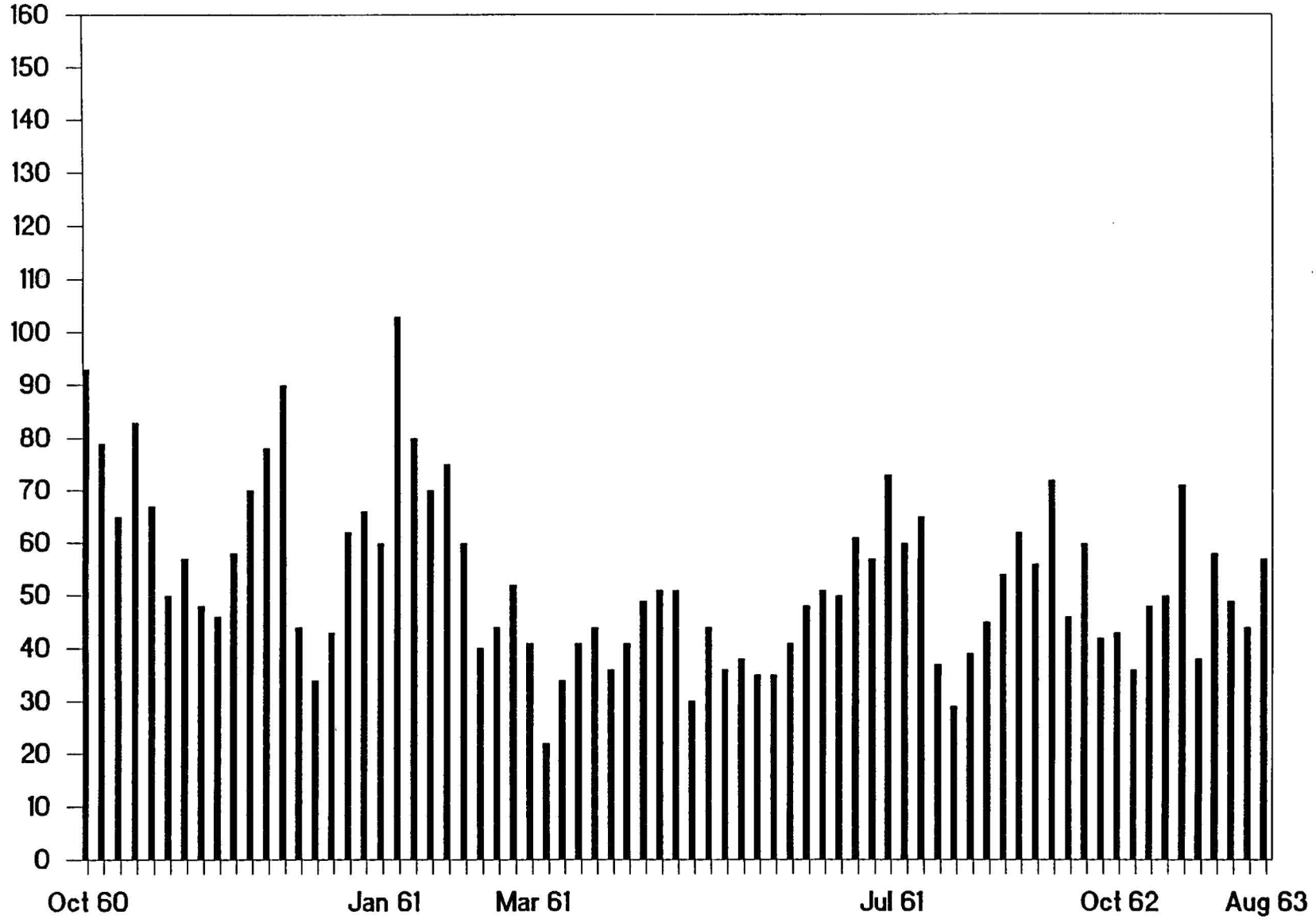

Figure 164. Graph of Calcium Versus Time For The Dardanelle Site 1960-1963.

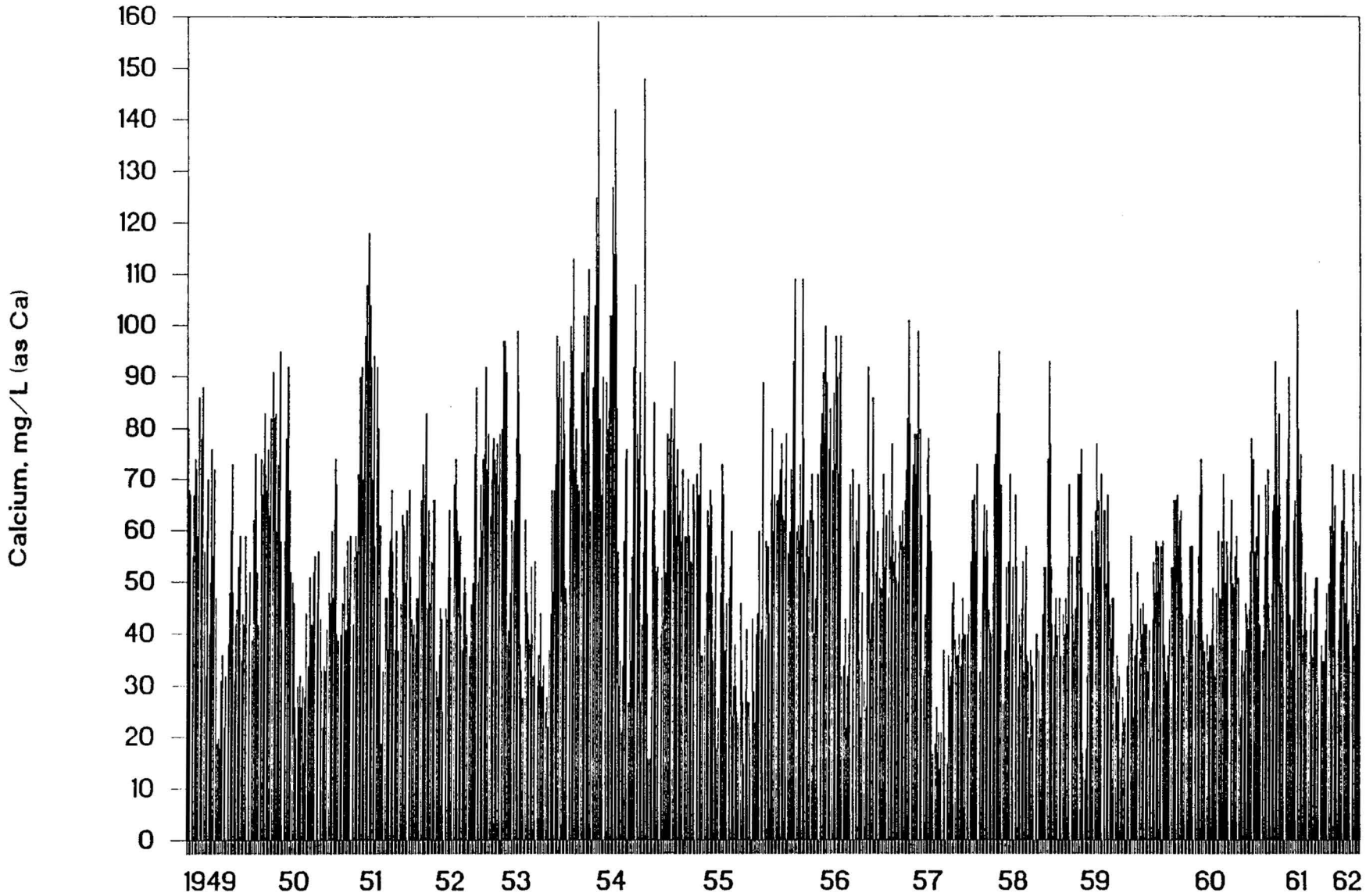

Figure 165. Graph of Calcium Versus Time For The Dardanelle Site 1948-1963.

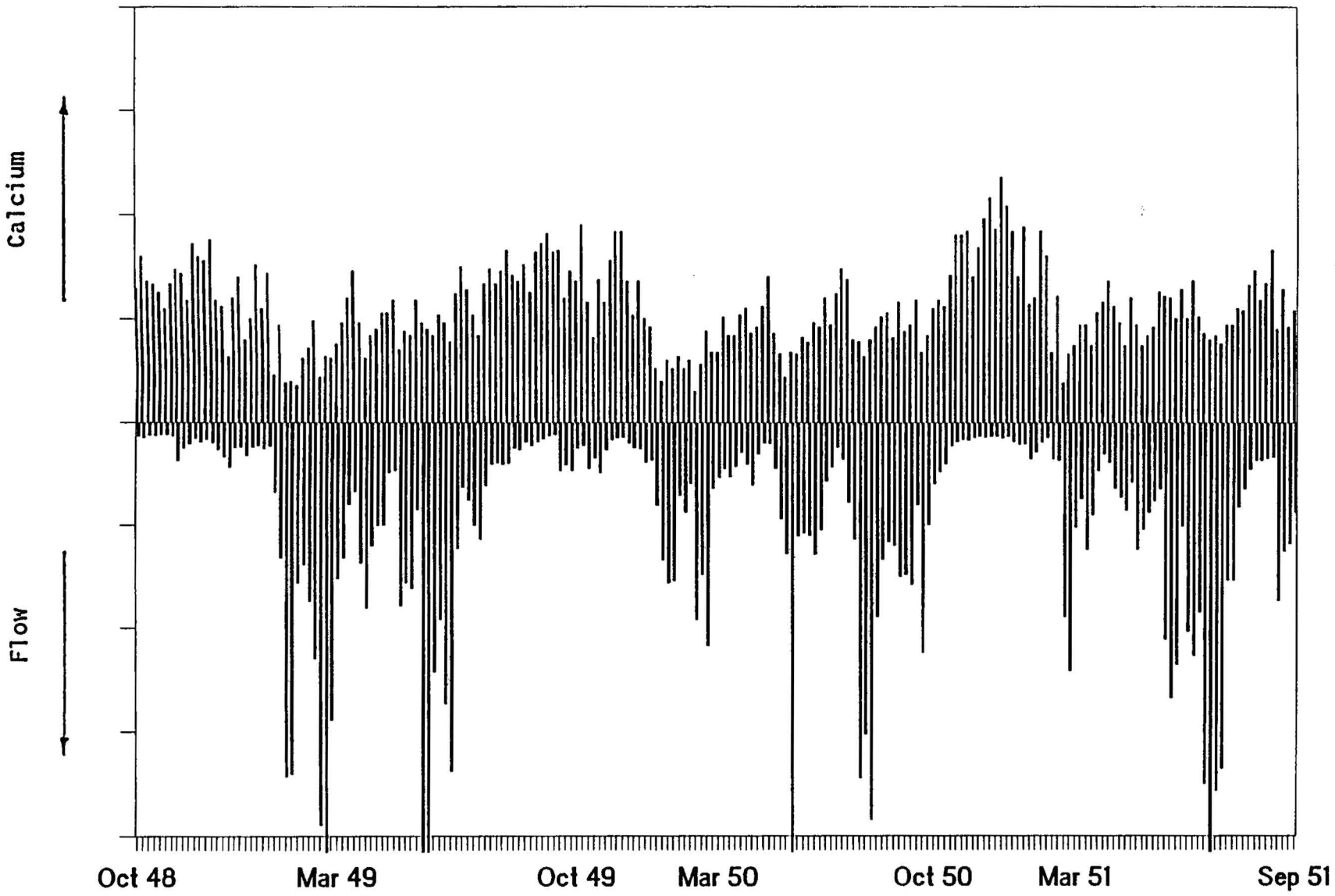

Figure 166. Graph of Calcium And Flow Versus Time For The Dardanelle Site 1948-1951.

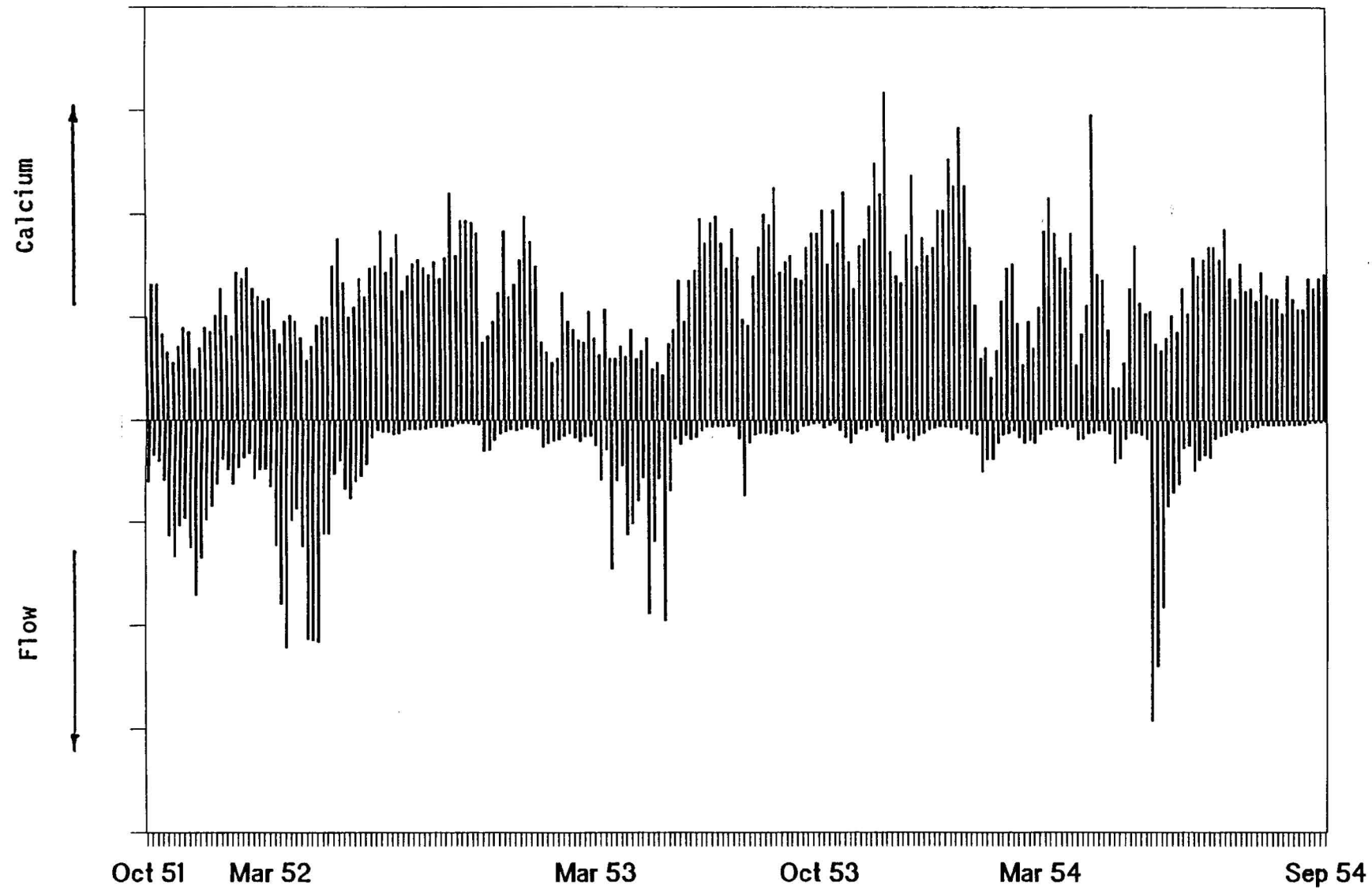

Figure 167. Graph of Calcium And Flow Versus Time For The Dardanelle Site 1951-1954.

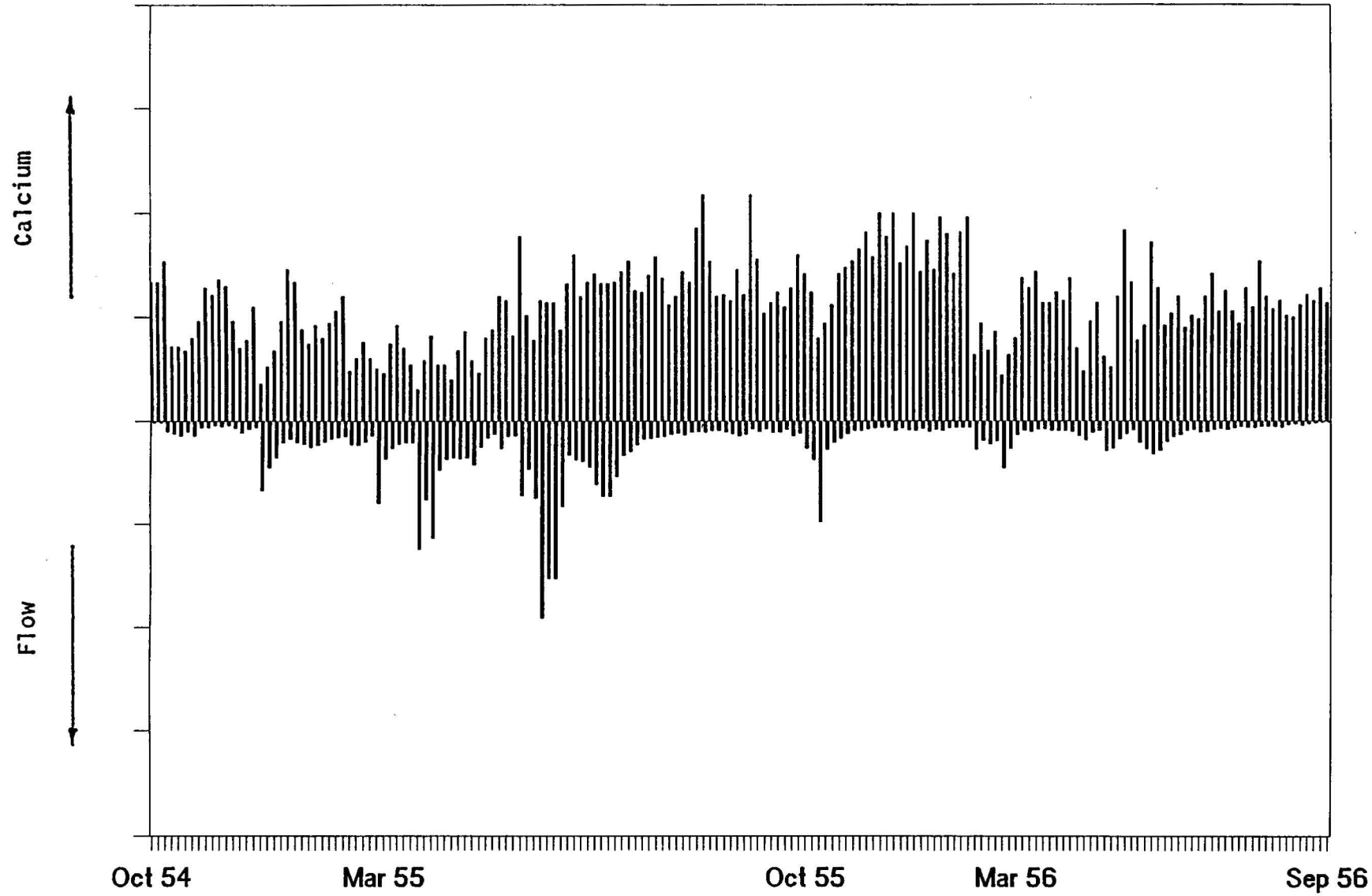

Figure 168. Graph of Calcium And Flow Versus Time For The Dardanelle Site 1954-1956.

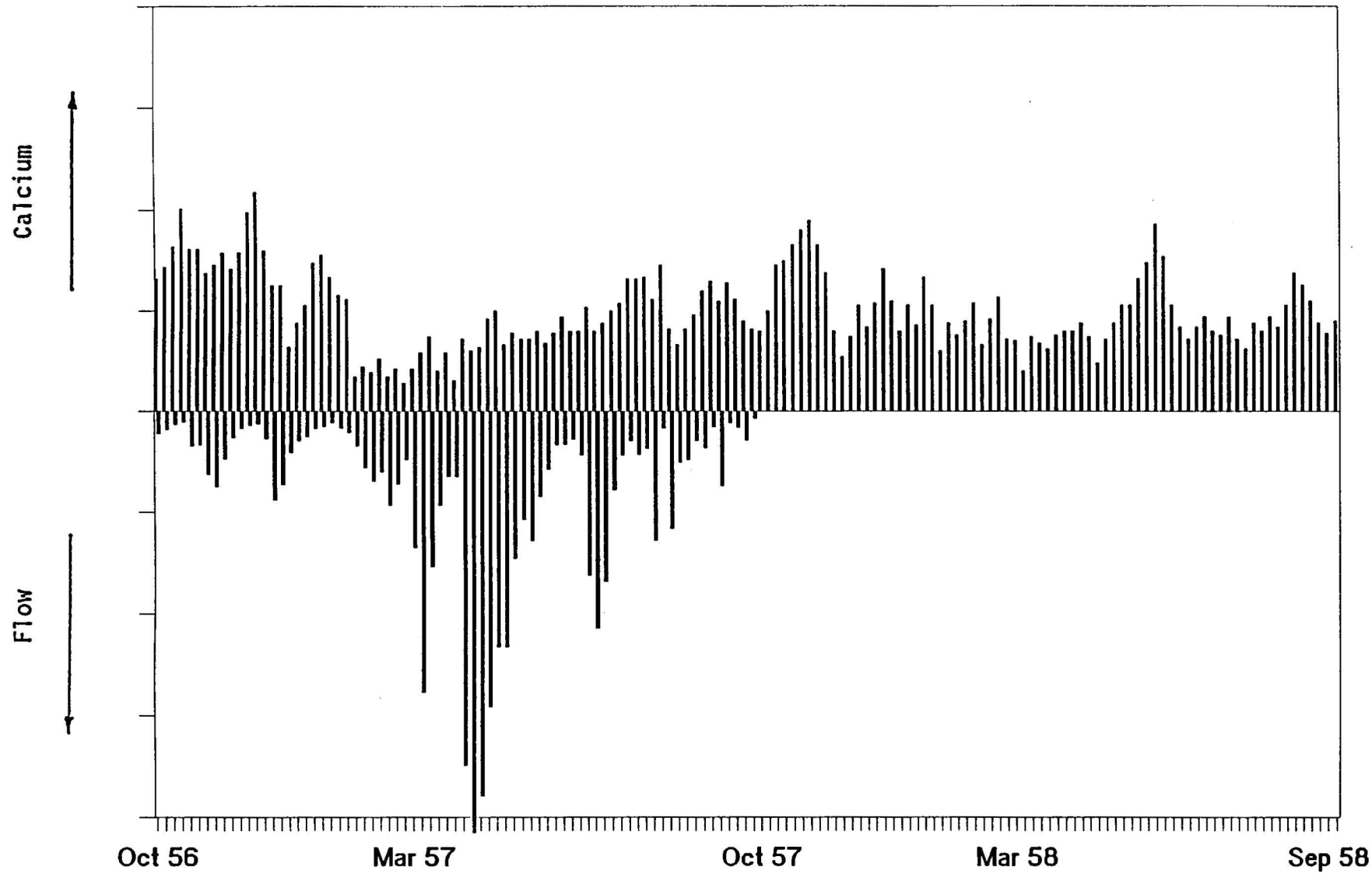

Figure 169. Graph of Calcium And Flow Versus Time For The Dardanelle Site 1956-1958.

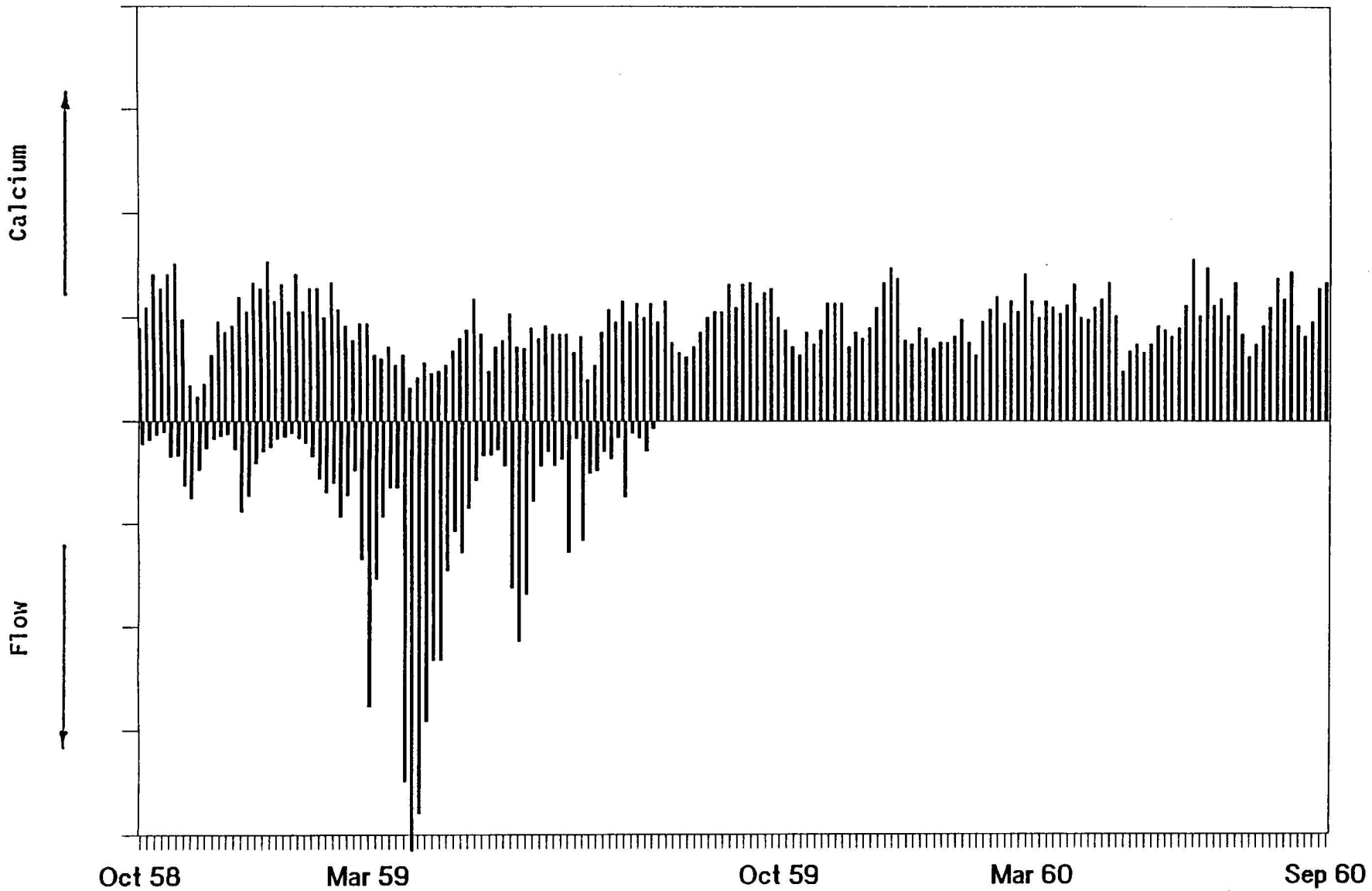

Figure 170. Graph of Calcium And Flow Versus Time For The Dardanelle Site 1958-1960.

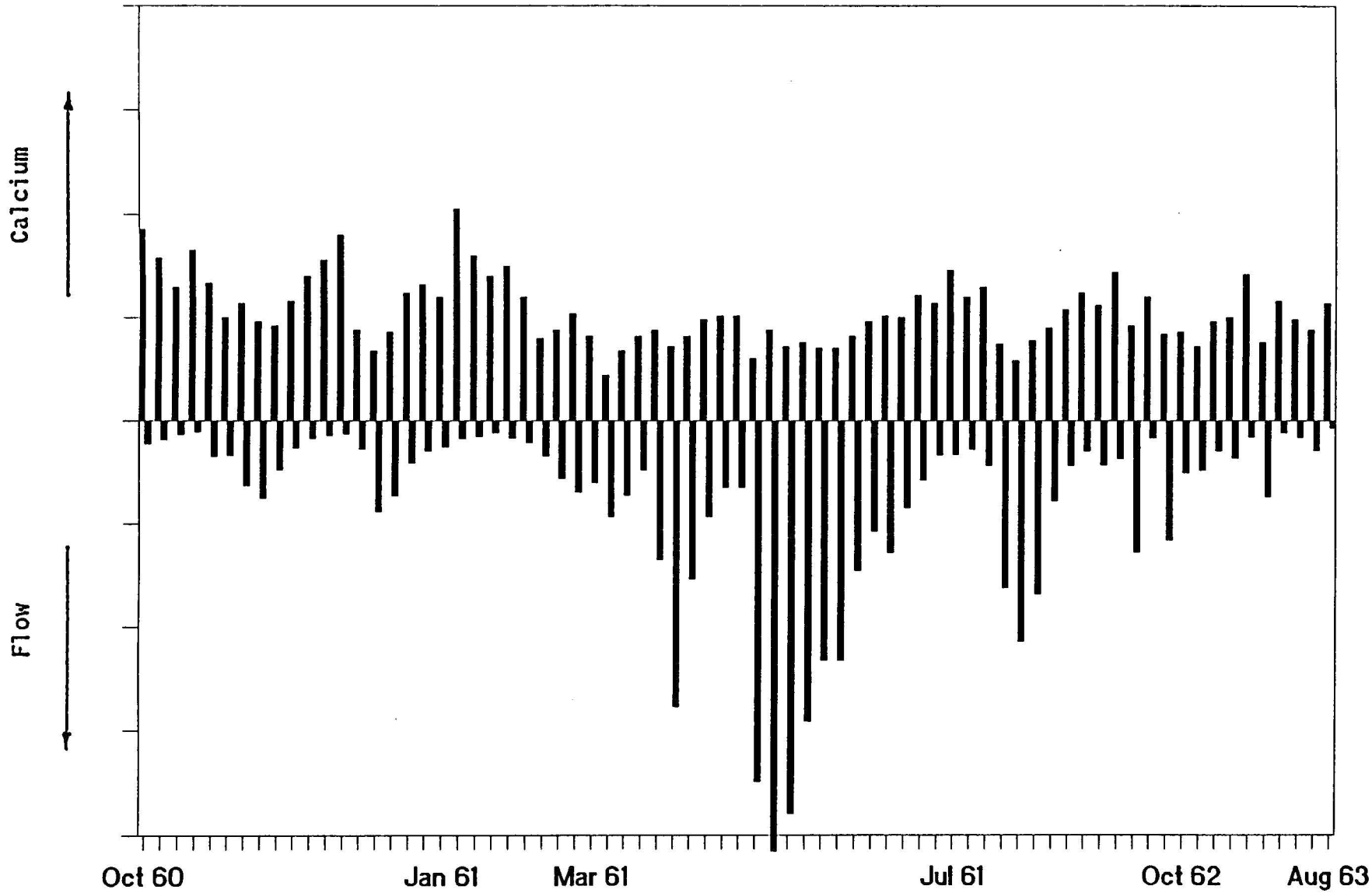

Figure 171. Graph of Calcium And Flow Versus Time For The Dardanelle Site 1960-1963.

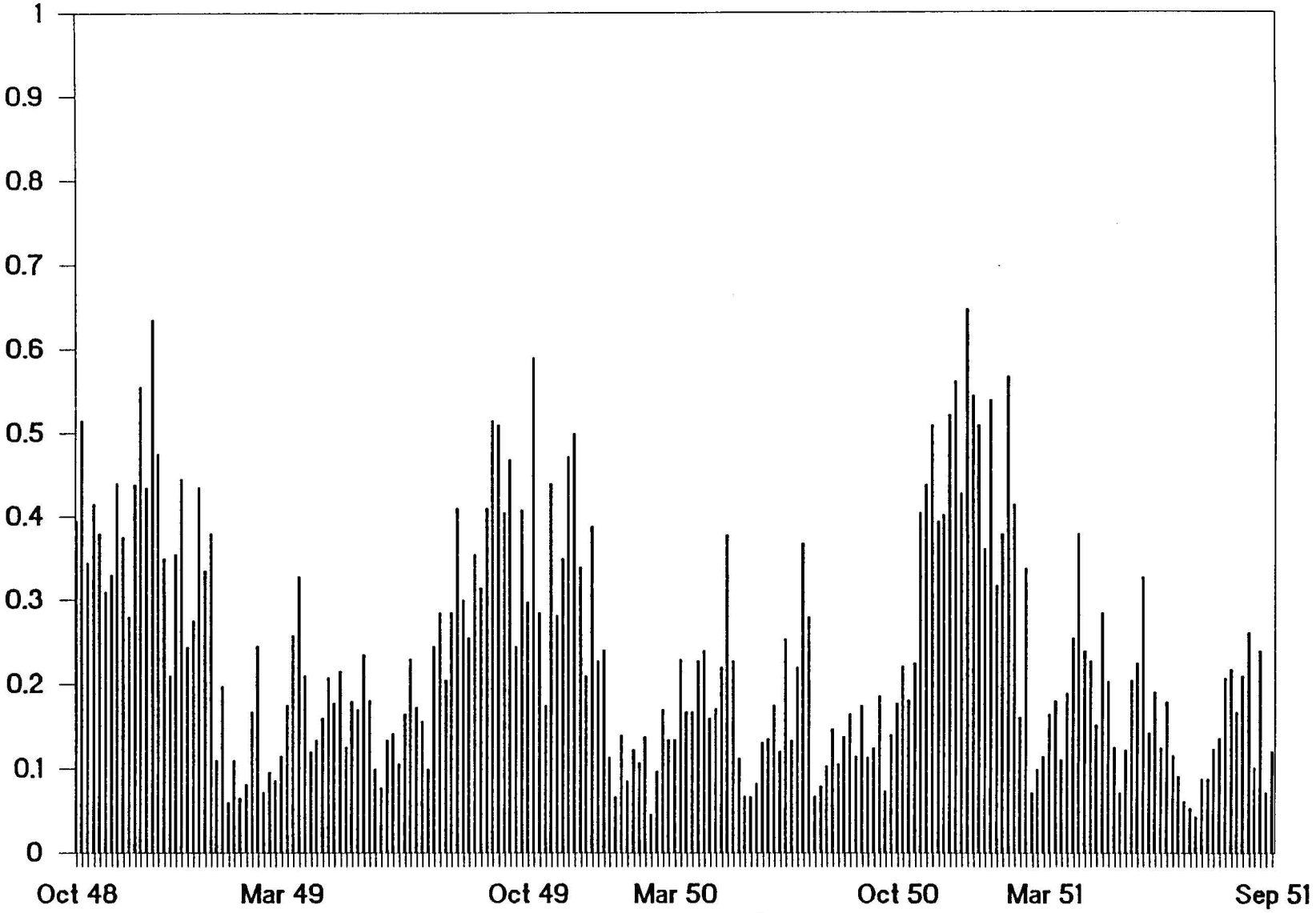

Figure 172. Graph of Chloride Versus Time For The Dardanelle Site 1948-1951.

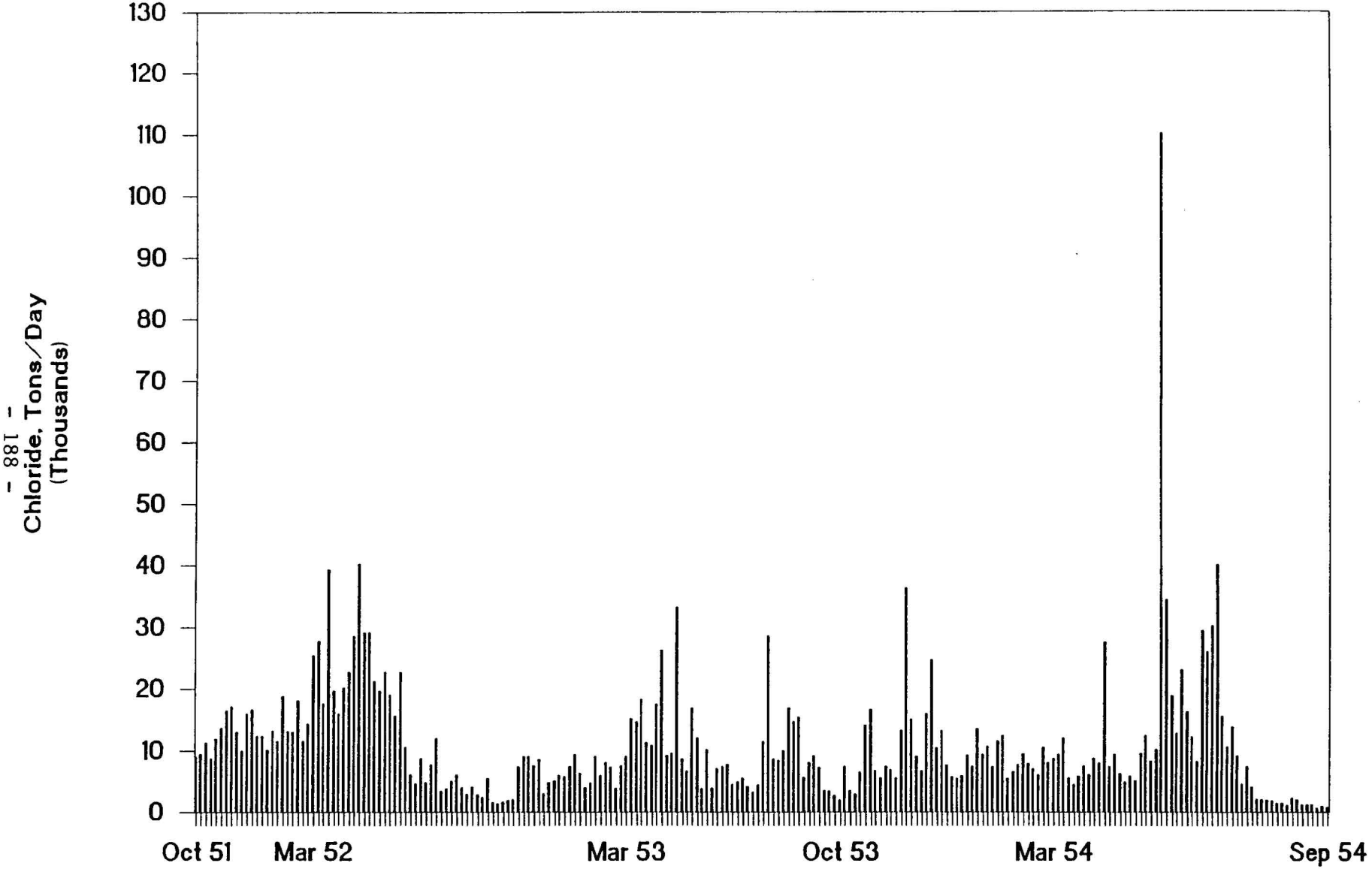

Figure 173. Graph of Chloride Versus Time For The Dardanelle Site 1951-1954.

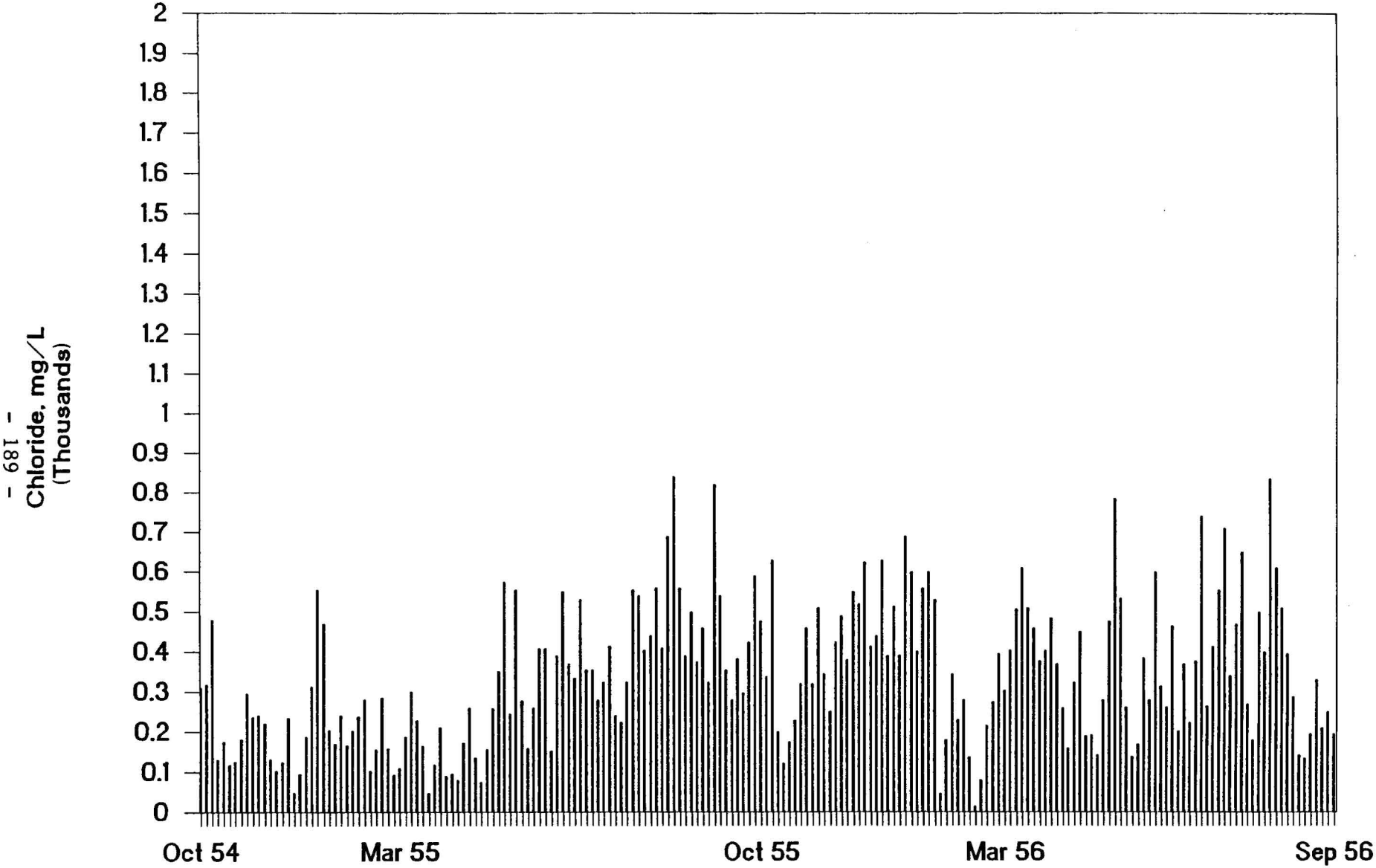

Figure 174. Graph of Chloride Versus Time For The Dardanelle Site 1954-1956.

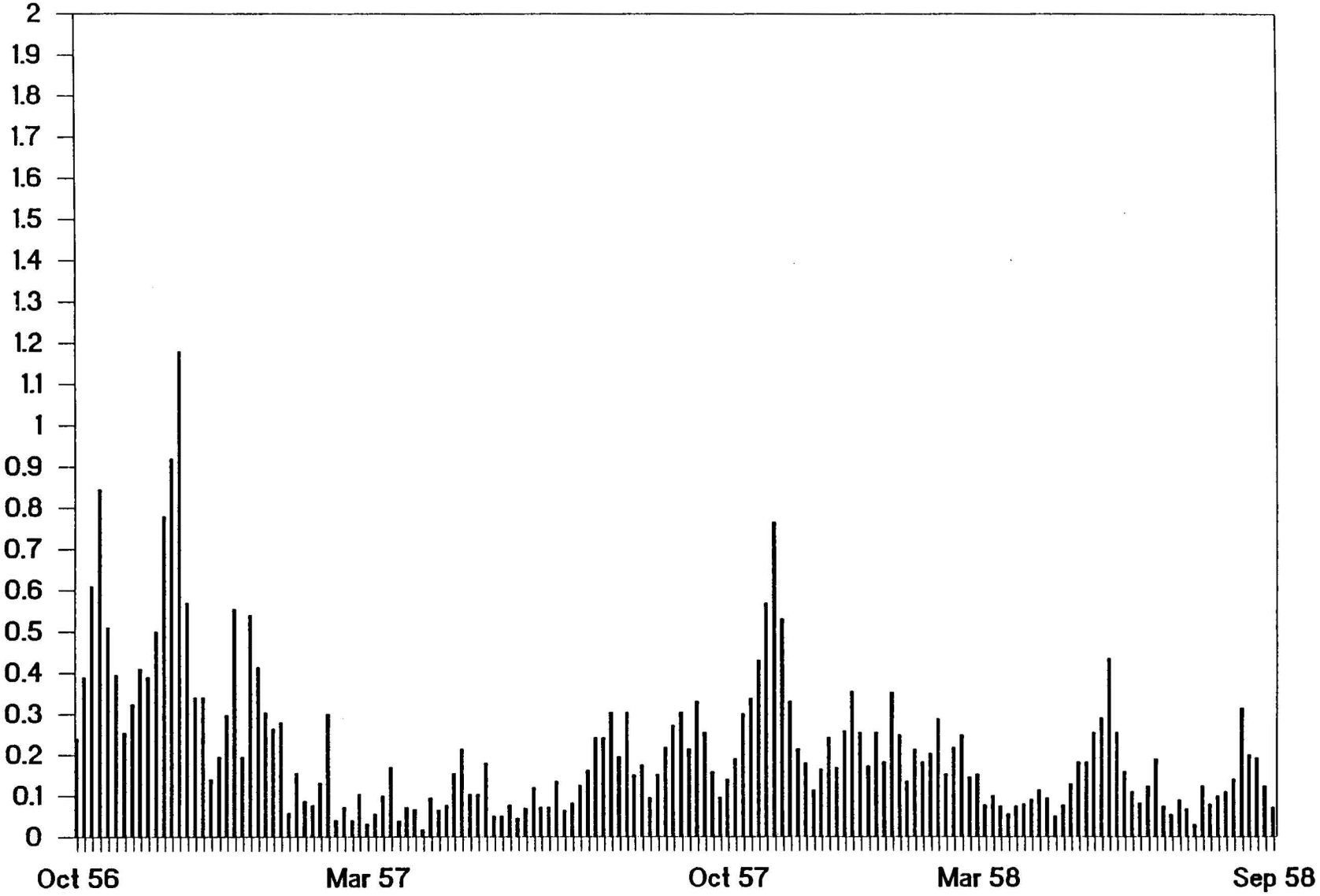

Figure 175. Graph of Chloride Versus Time For The Dardanelle Site 1956-1958.

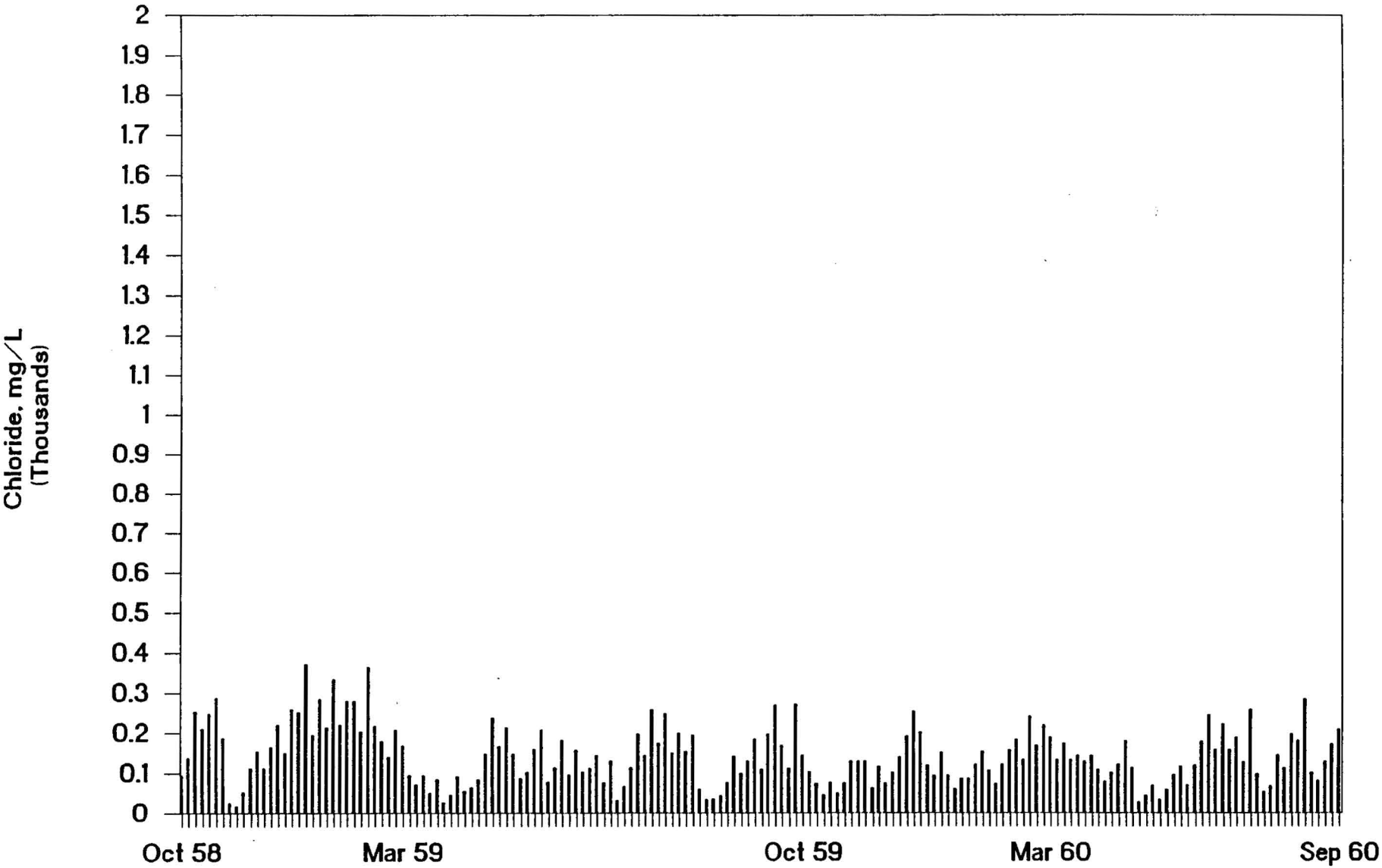

Figure 176. Graph of Chloride Versus Time For The Dardanelle Site 1958-1960.

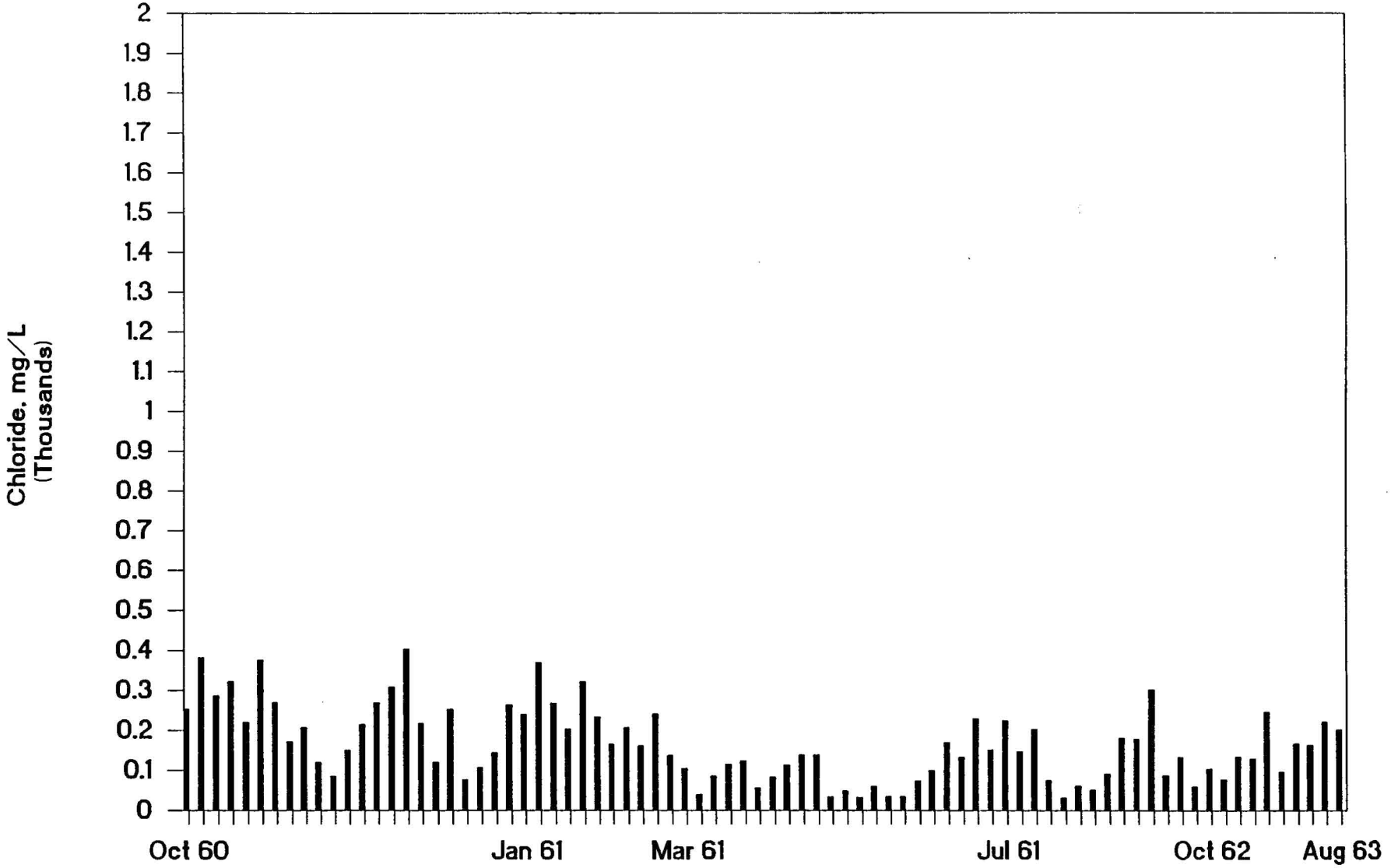

Figure 177. Graph of Chloride Versus Time For The Dardanelle Site 1960-1963.

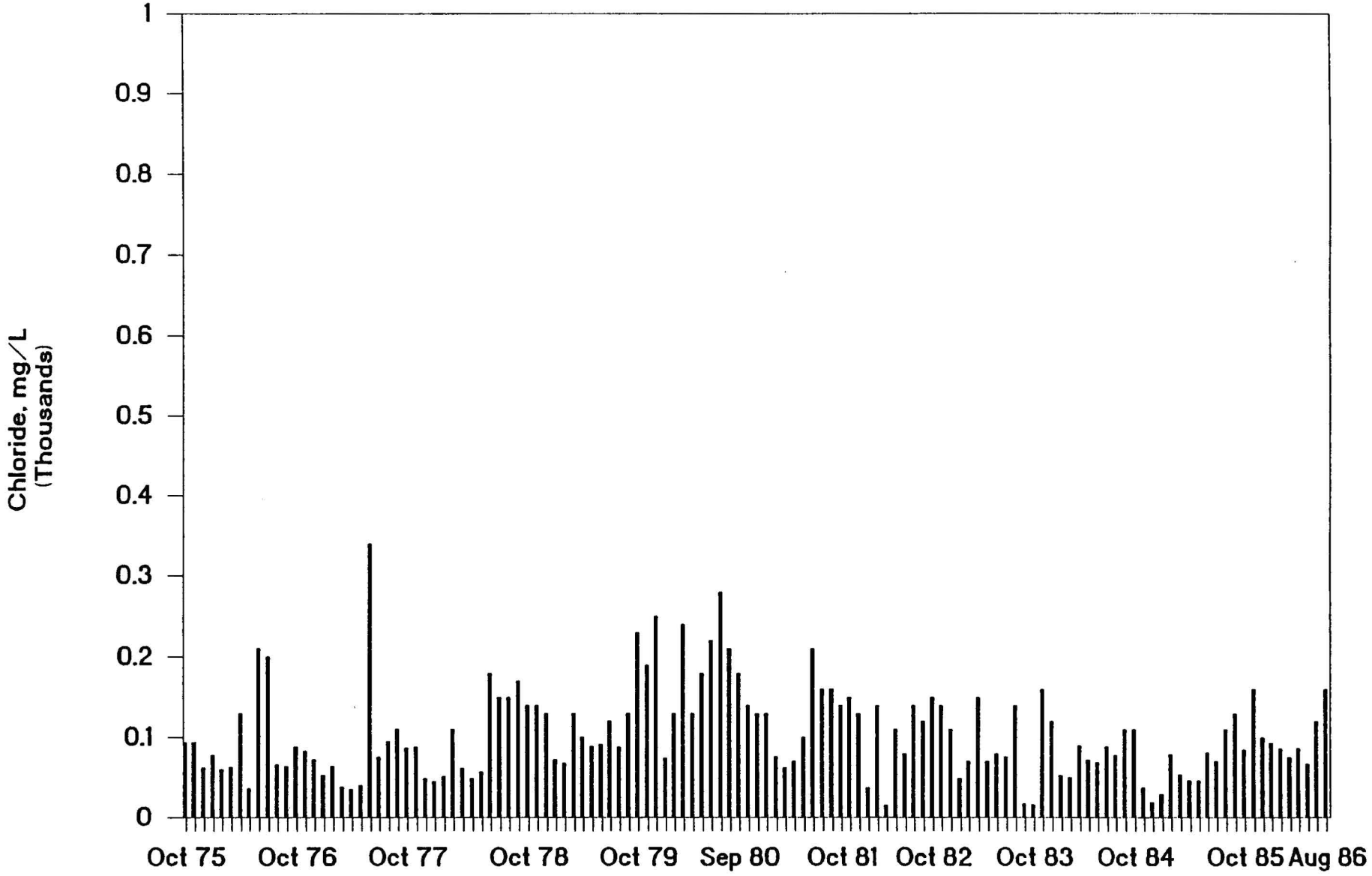

Figure 178. Graph of Chloride Versus Time For The Dardanelle Site 1975-1986.

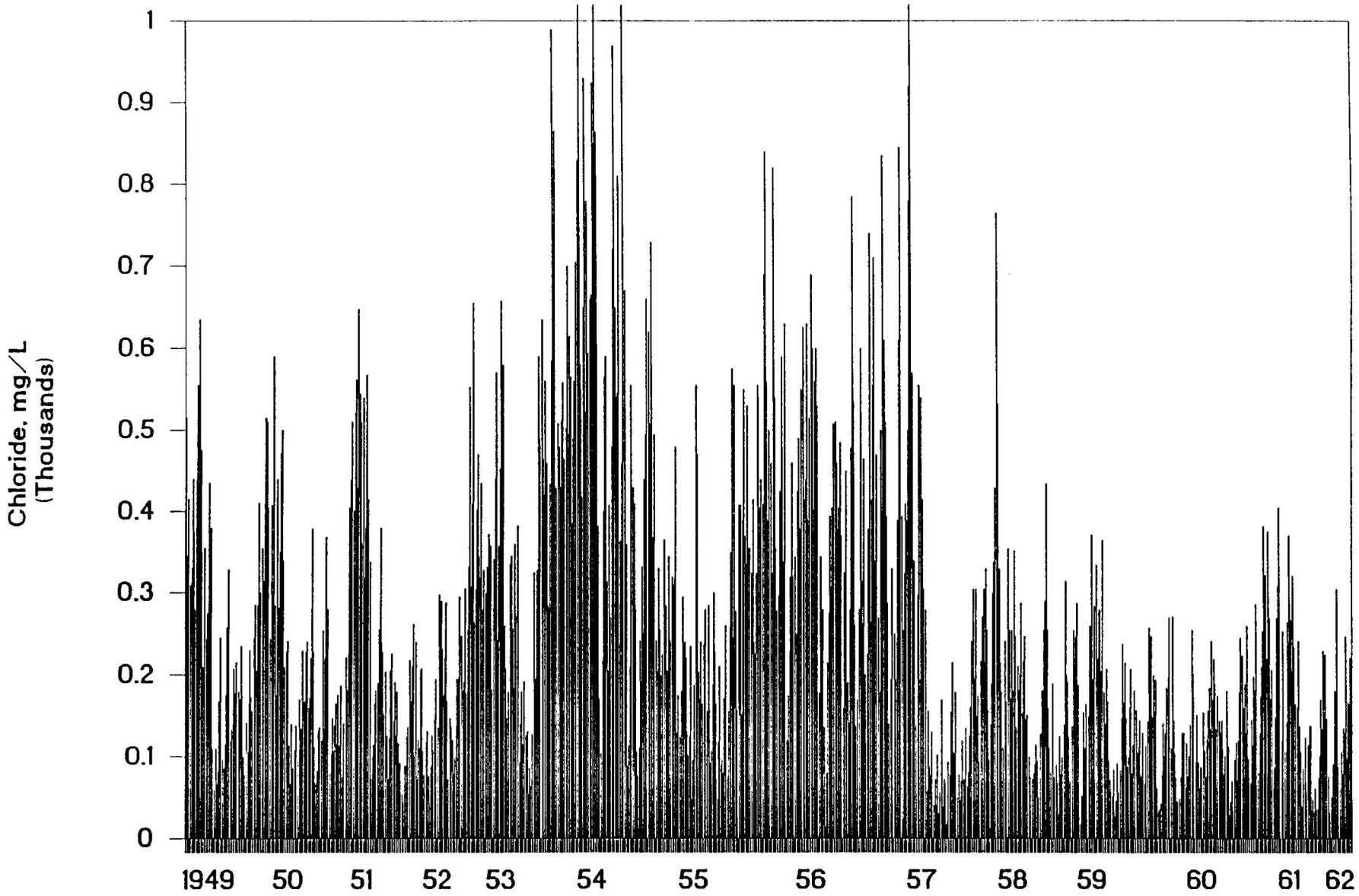

Figure 179. Graph of Chloride Versus Time For The Dardanelle Site 1948-1963.

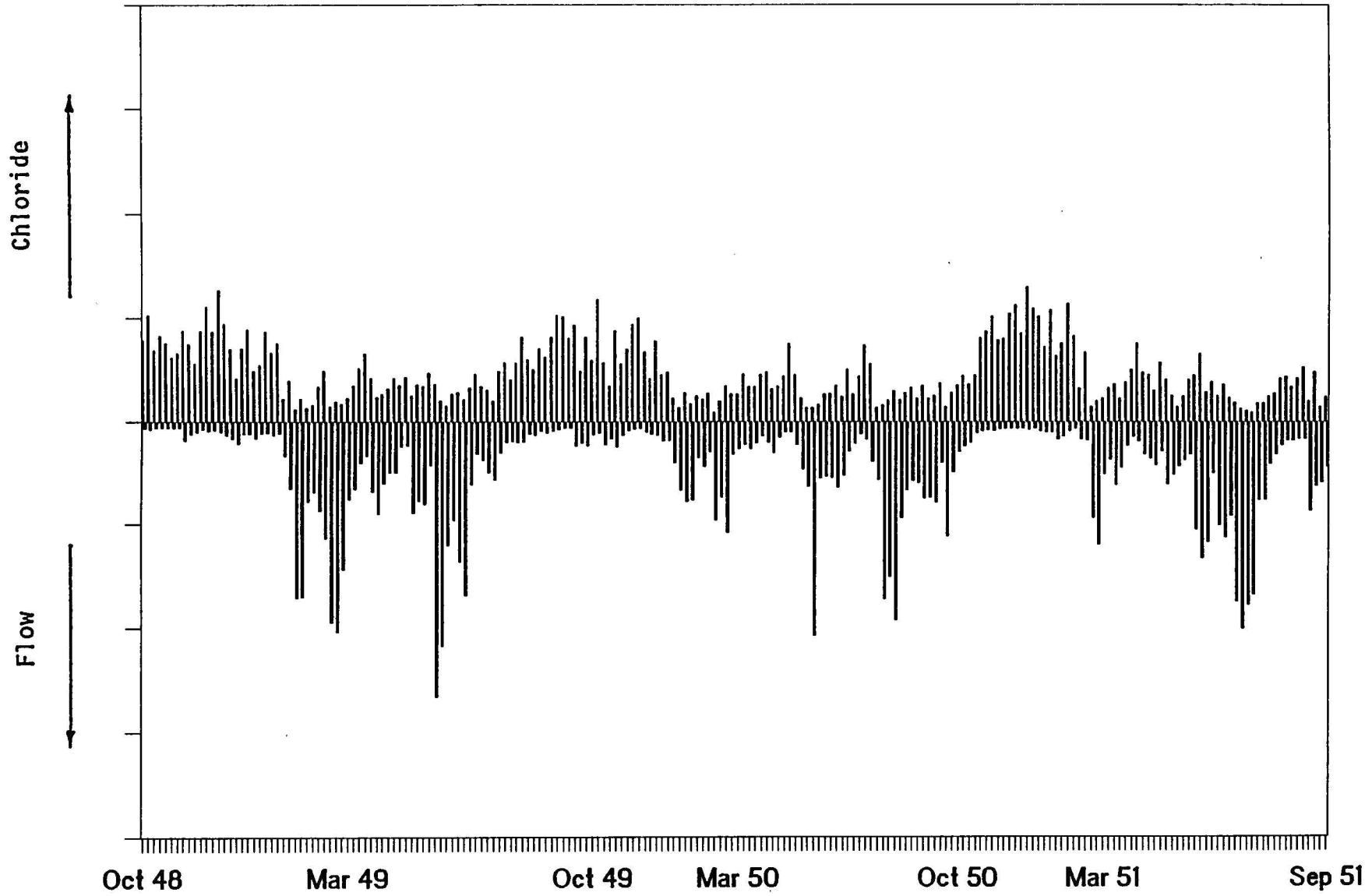

Figure 180. Graph of Chloride And Flow Versus Time For The Dardanelle Site 1948-1951.

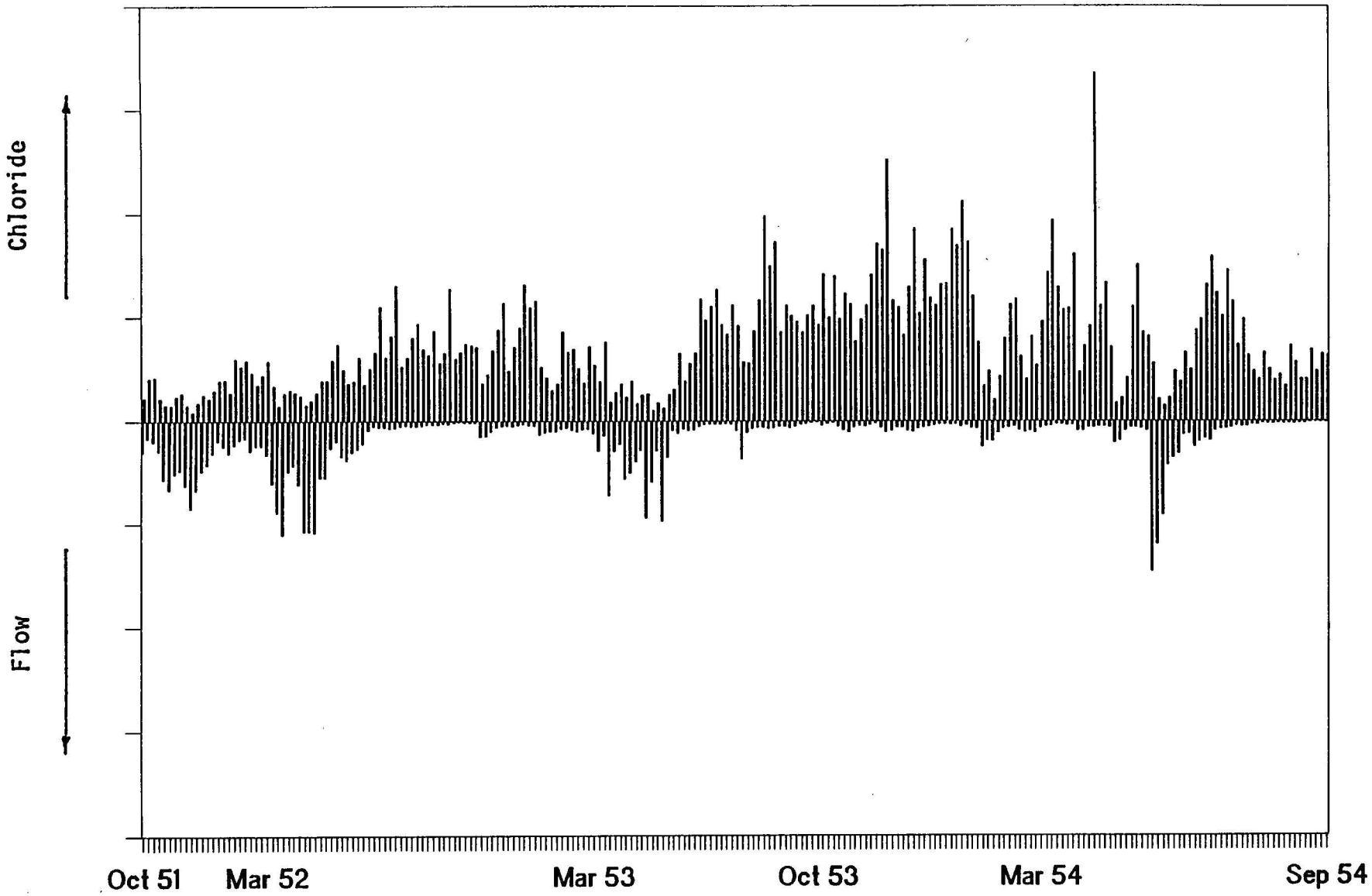

Figure 181. Graph of Chloride And Flow Versus Time For The Dardanelle Site 1951-1954.

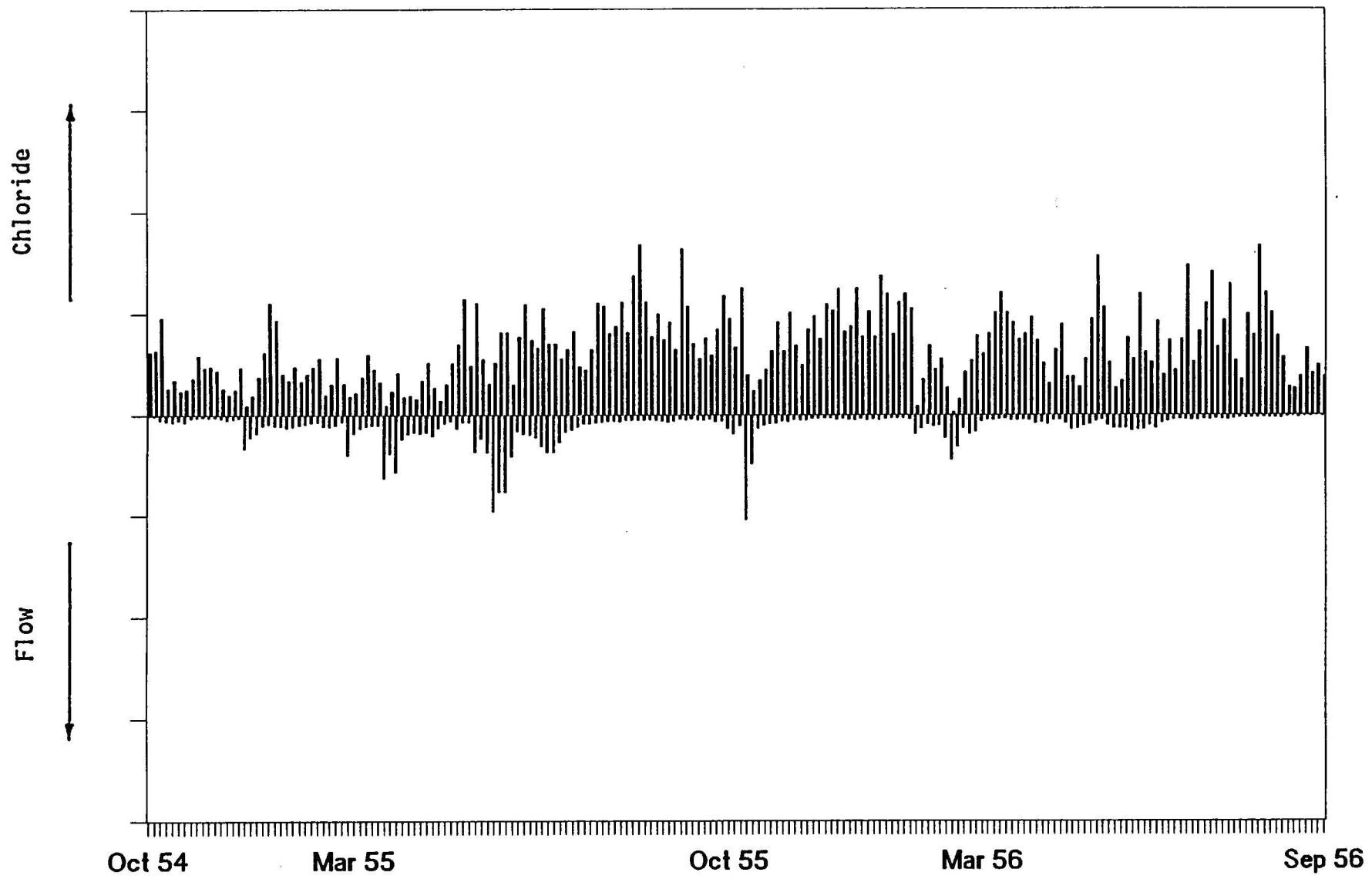

Figure 182. Graph of Chloride And Flow Versus Time For The Dardanelle Site 1954-1956.

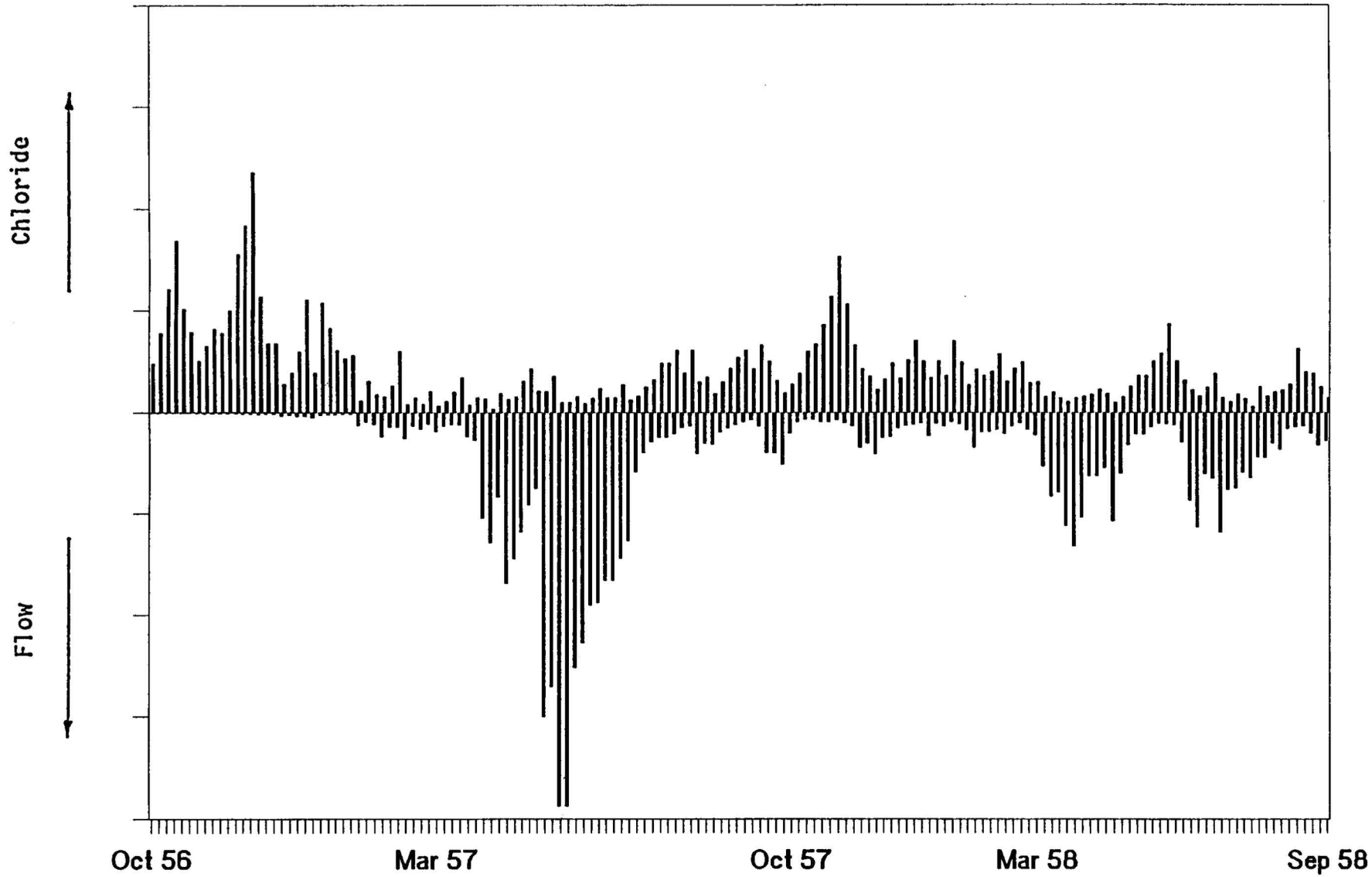

Figure 183. Graph of Chloride And Flow Versus Time For The Dardanelle Site 1956-1958.

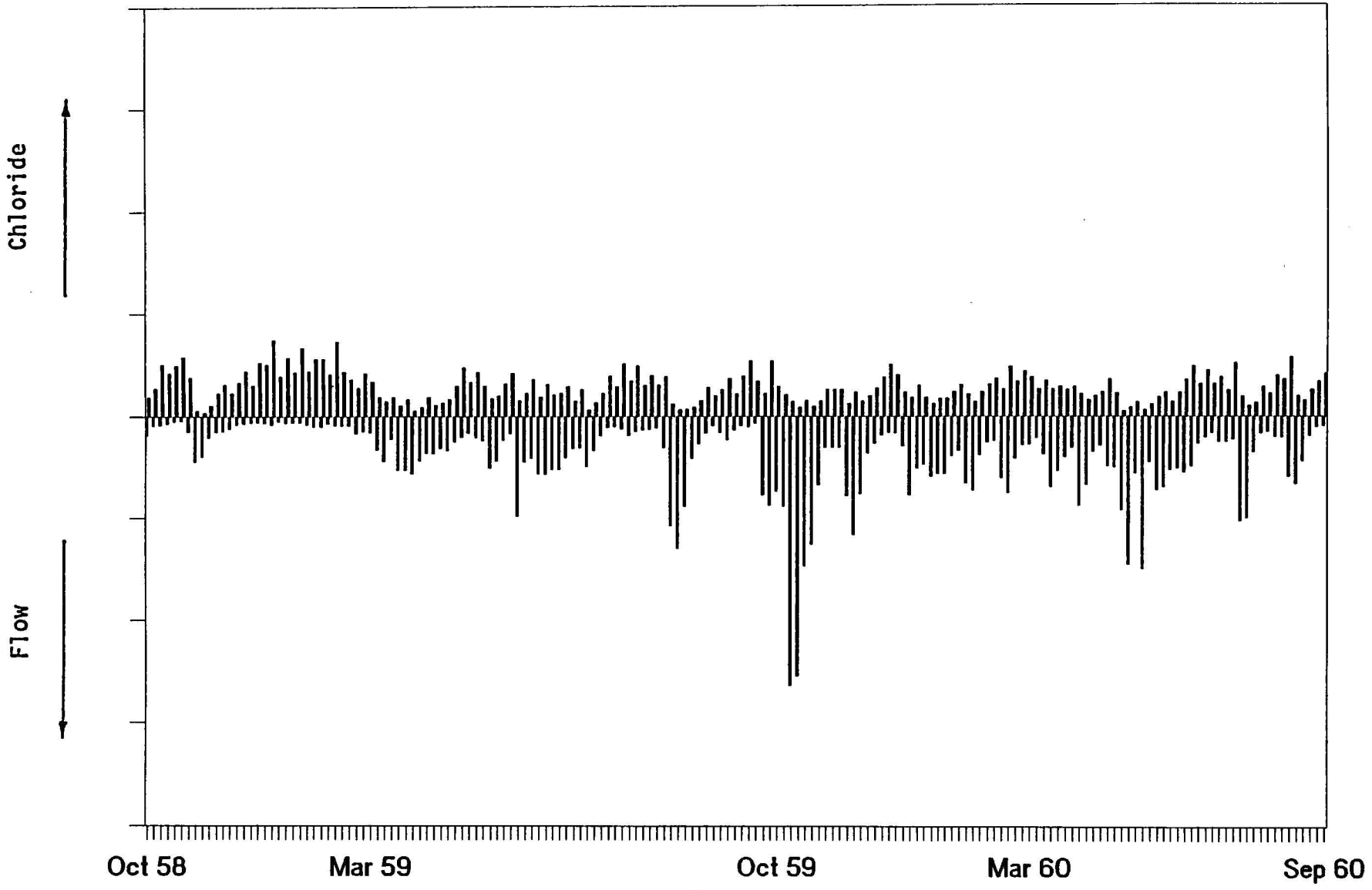

Figure 184. Graph of Chloride And Flow Versus Time For The Dardanelle Site 1958-1960.

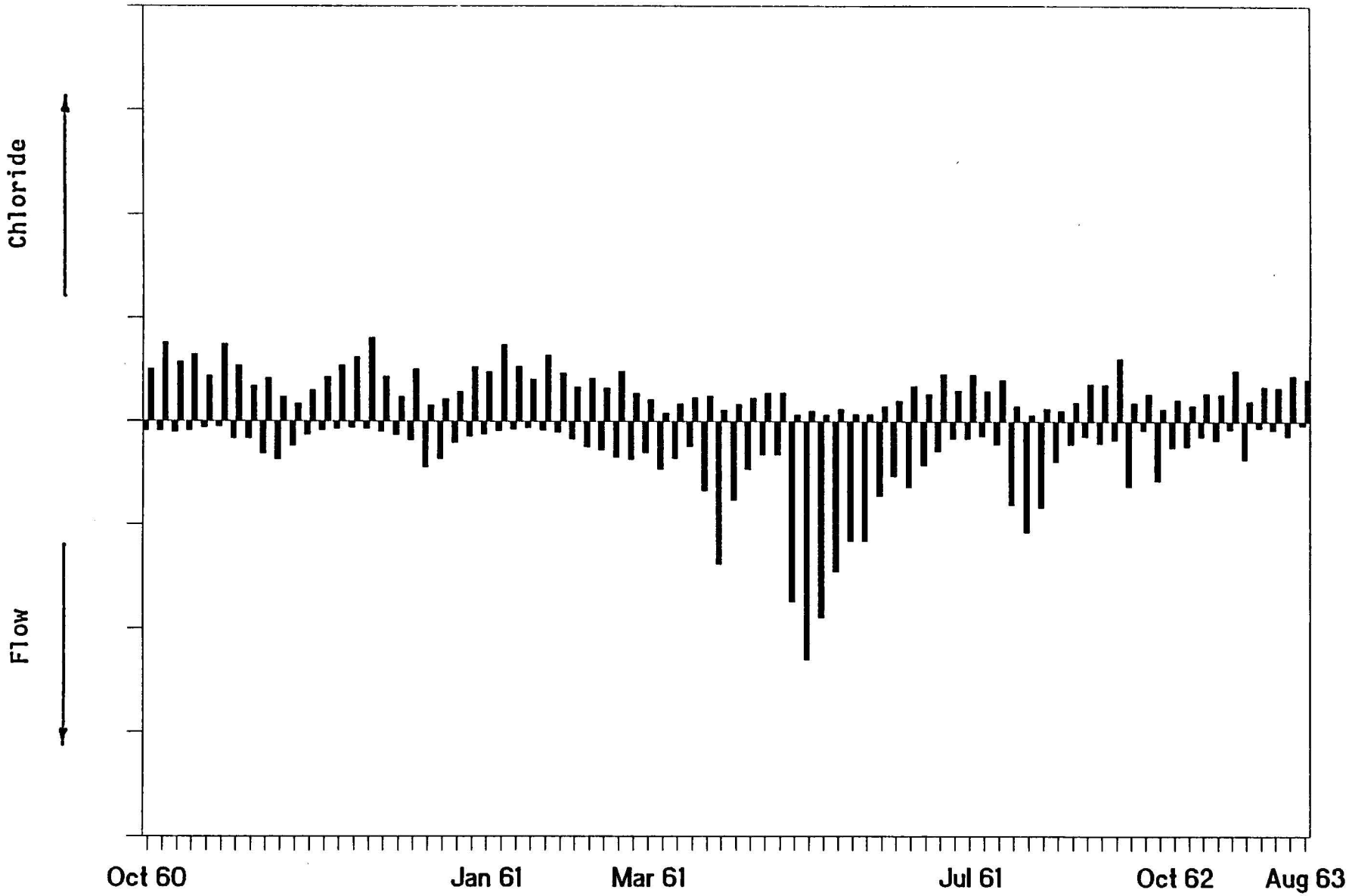

Figure 185. Graph of Chloride And Flow Versus Time For The Dardanelle Site 1960-1963.

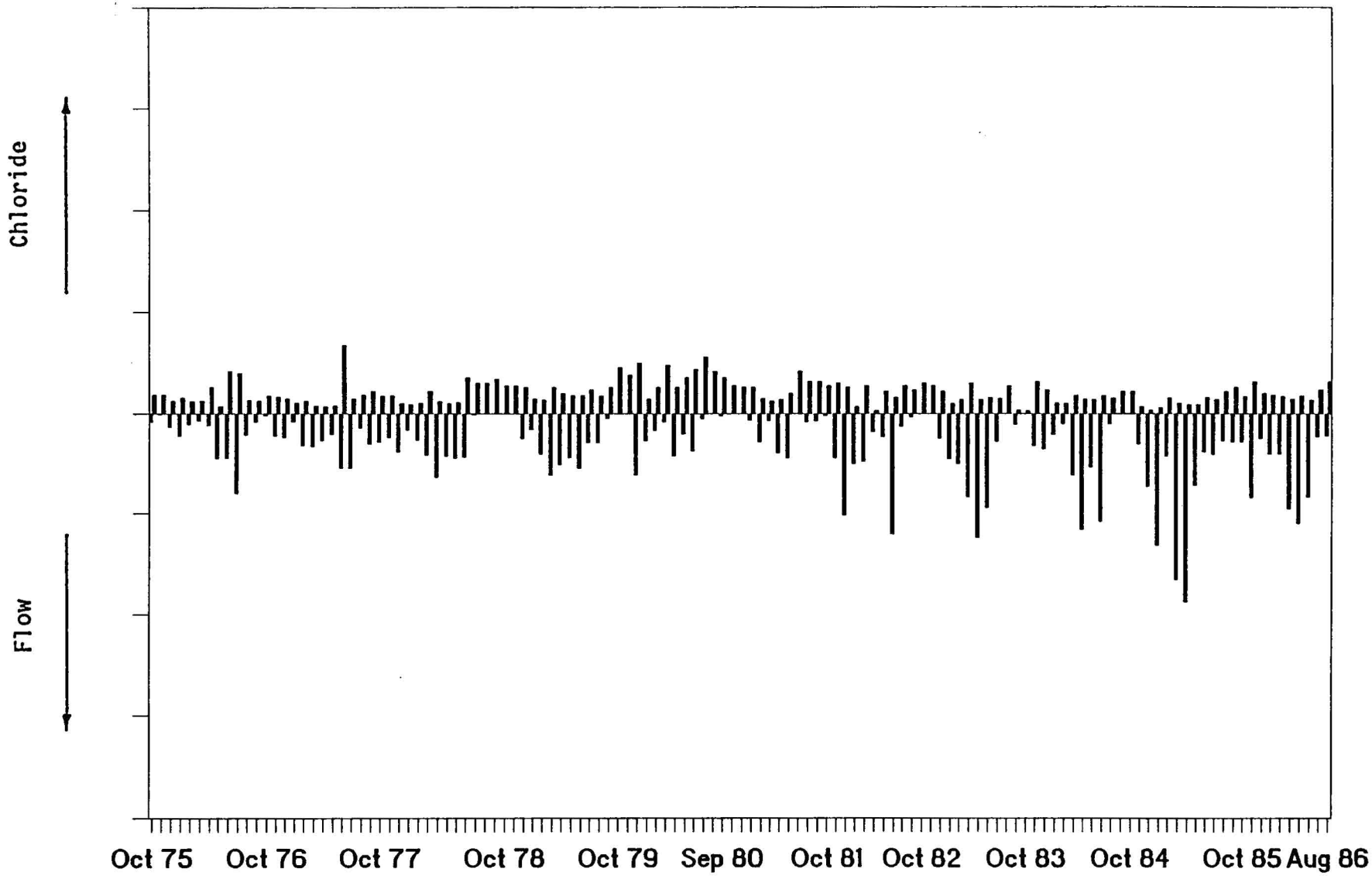

Figure 186. Graph of Chloride And Flow Versus Time For The Dardanelle Site 1960-1963.

As shown by the figure, there was a general tendency for larger chloride concentrations at lower flows and smaller chloride concentrations at larger flows. The period of record included data from 1948 until 1986. Figures 187 through 193 show chloride in tons per day for the Dardanelle site.

Coliform. The average coliform count was 293 colonies per 100 mL. The minimum and maximum counts were 4 and 4,800 colonies, respectively. The coliform data are shown in Figure 194. One-hundred twenty-two coliform values were included in the data base. It is interesting to note that the coliform concentrations were much smaller from about 1979 until 1986 than for prior years. Coliforms and flow are both plotted in Figure 195 as a function of time.

Dissolved Solids. The overall average dissolved solids concentration was 649 mg/L. However, the average concentrations prior to 1963 and after 1977 were substantially different. The average dissolved solids concentration from 1948 until 1963 was 675 mg/L. The minimum and maximum concentrations were 65 and 3,140 mg/L, respectively. For the period of record from 1977 until 1986, the average dissolved solids concentration was 365 mg/L. The minimum and maximum concentrations for this period were 74 and 641 mg/L, respectively. The dissolved solids data are shown for short-term periods in Figures 196 through 202. Dissolved solids and flow are plotted as a function of time in Figures 203 through 209.

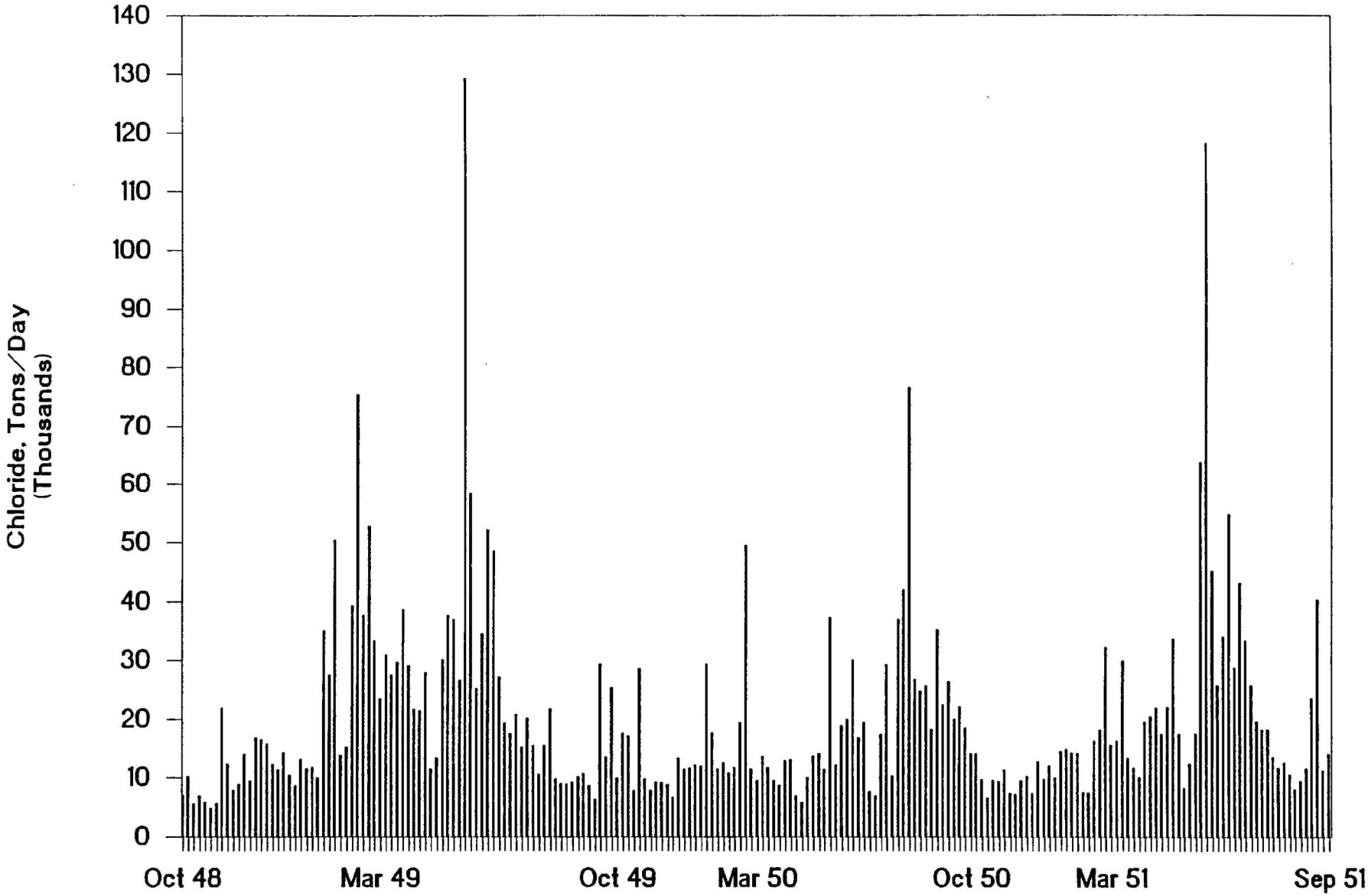

Figure 187. Graph of Chloride (Tons per Day) Versus Time For The Dardanelle Site 1948-1951.

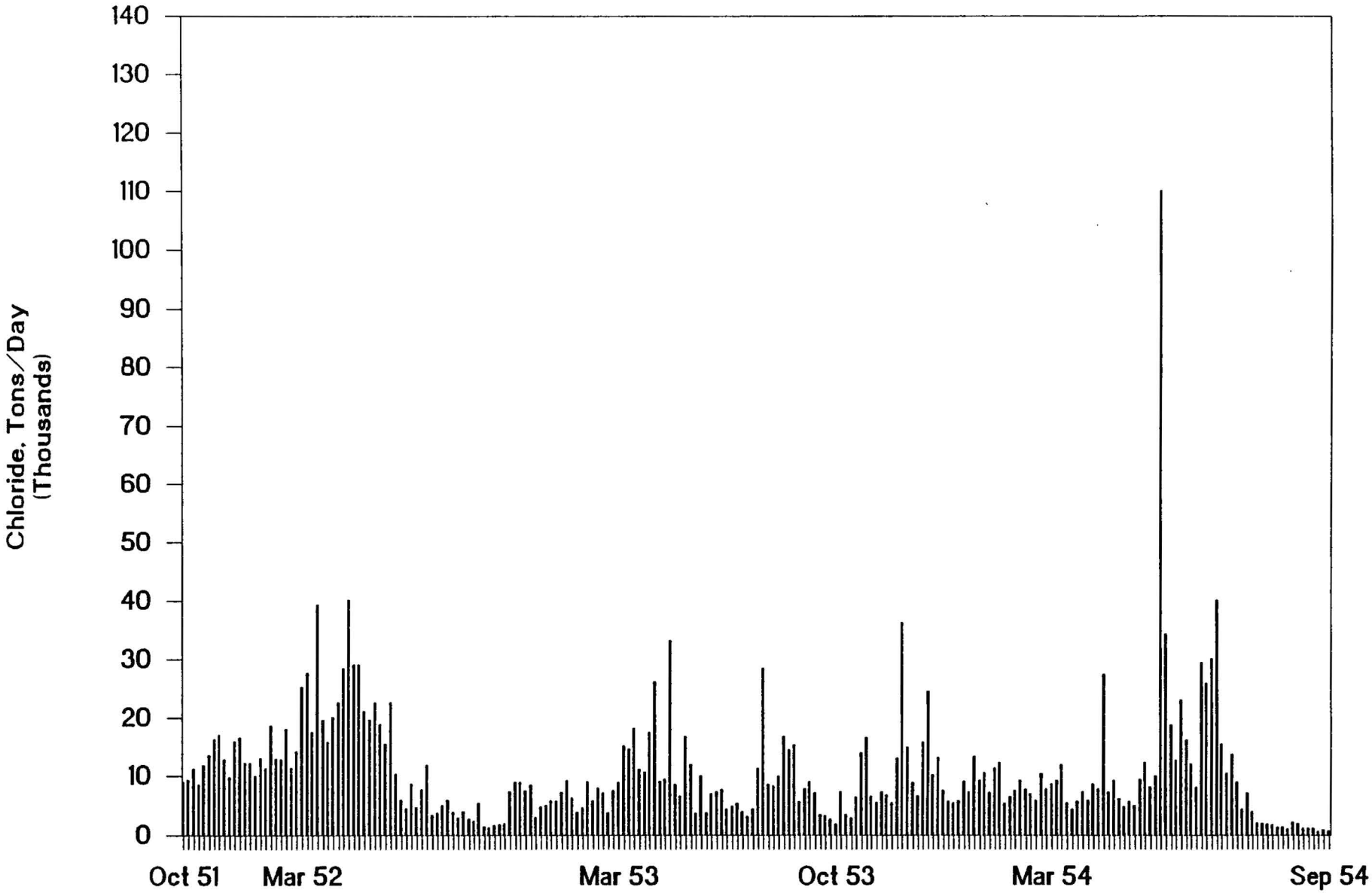

Figure 188. Graph of Chloride (Tons per Day) Versus Time For The Dardanelle Site 1951-1954.

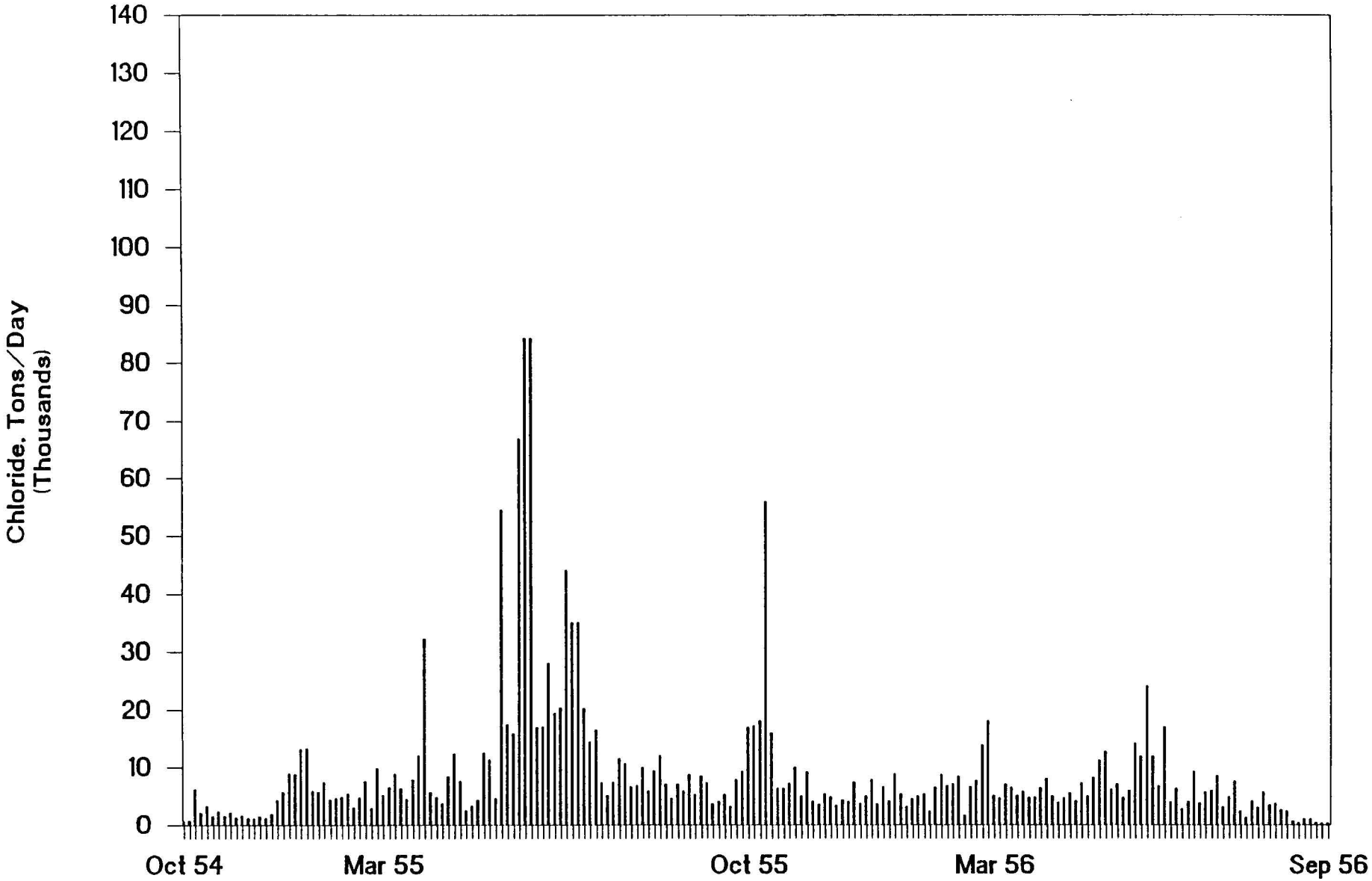

Figure 189. Graph of Chloride (Tons per Day) Versus Time For The Dardanelle Site 1954-1956.

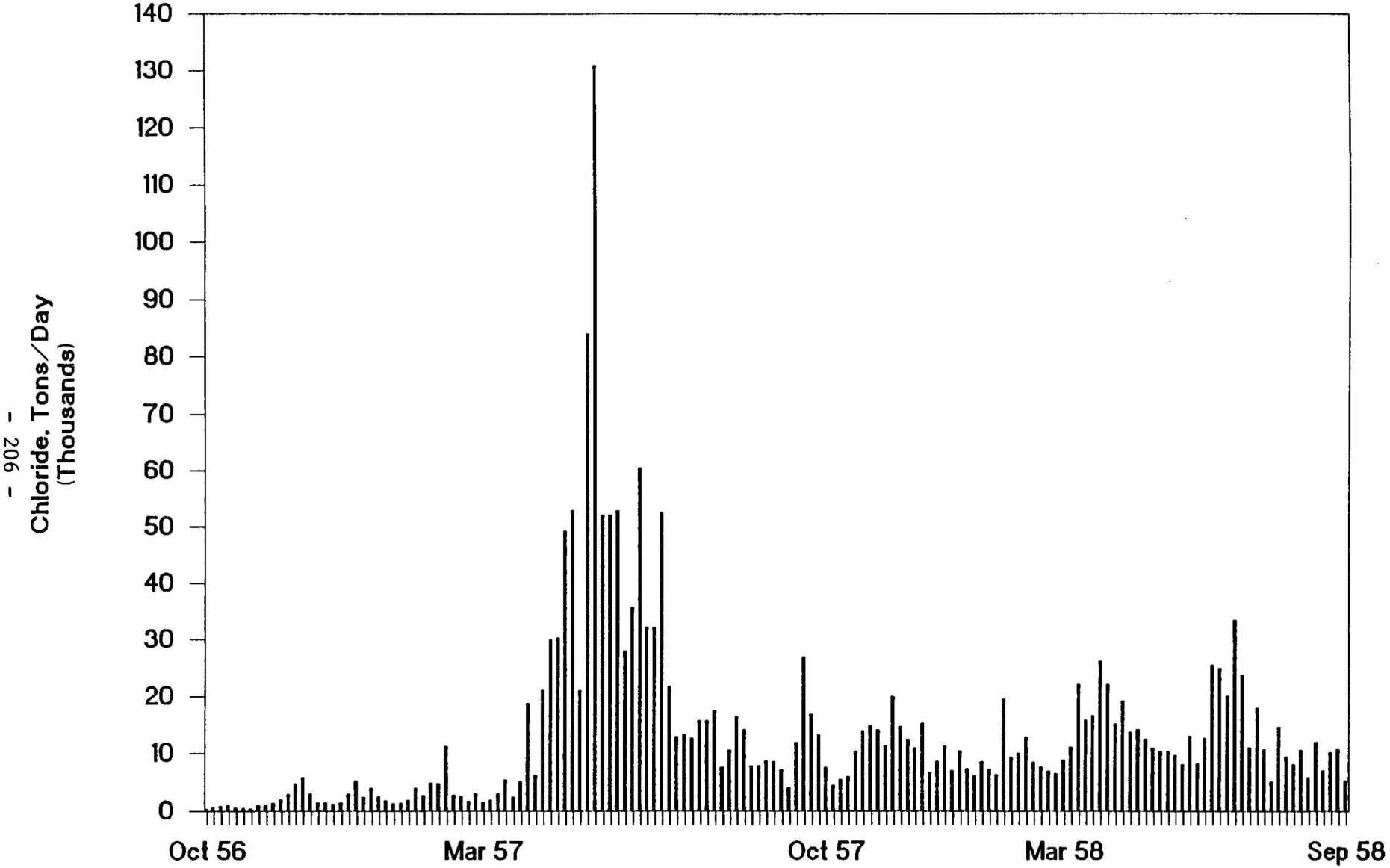

Figure 190. Graph of Chloride (Tons per Day) Versus Time For The Dardanelle Site 1956-1958.

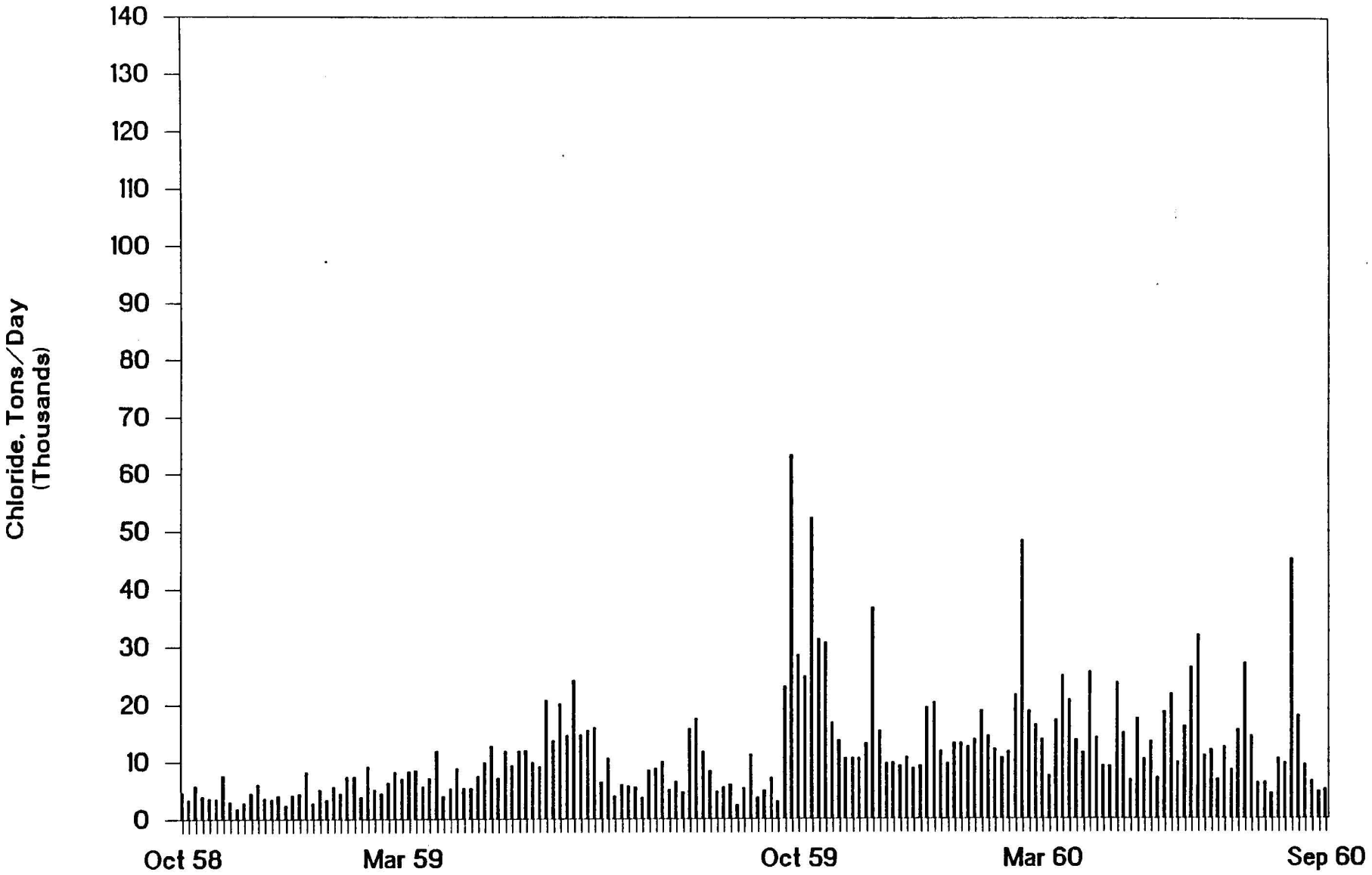

Figure 191. Graph of Chloride (Tons per Day) Versus Time For The Dardanelle Site 1958-1960.

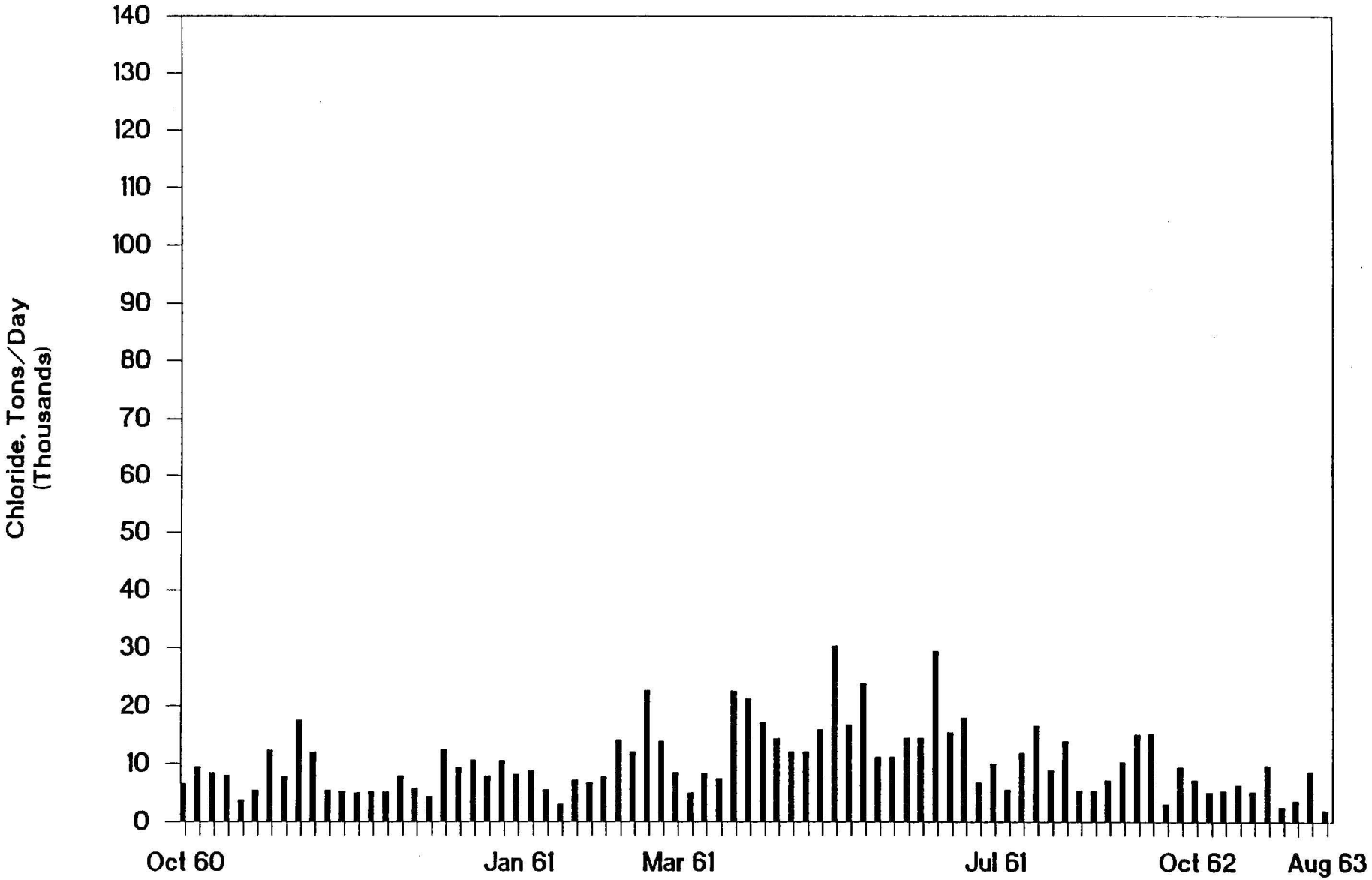

Figure 192. Graph of Chloride (Tons per Day) Versus Time For The Dardanelle Site 1960-1963.

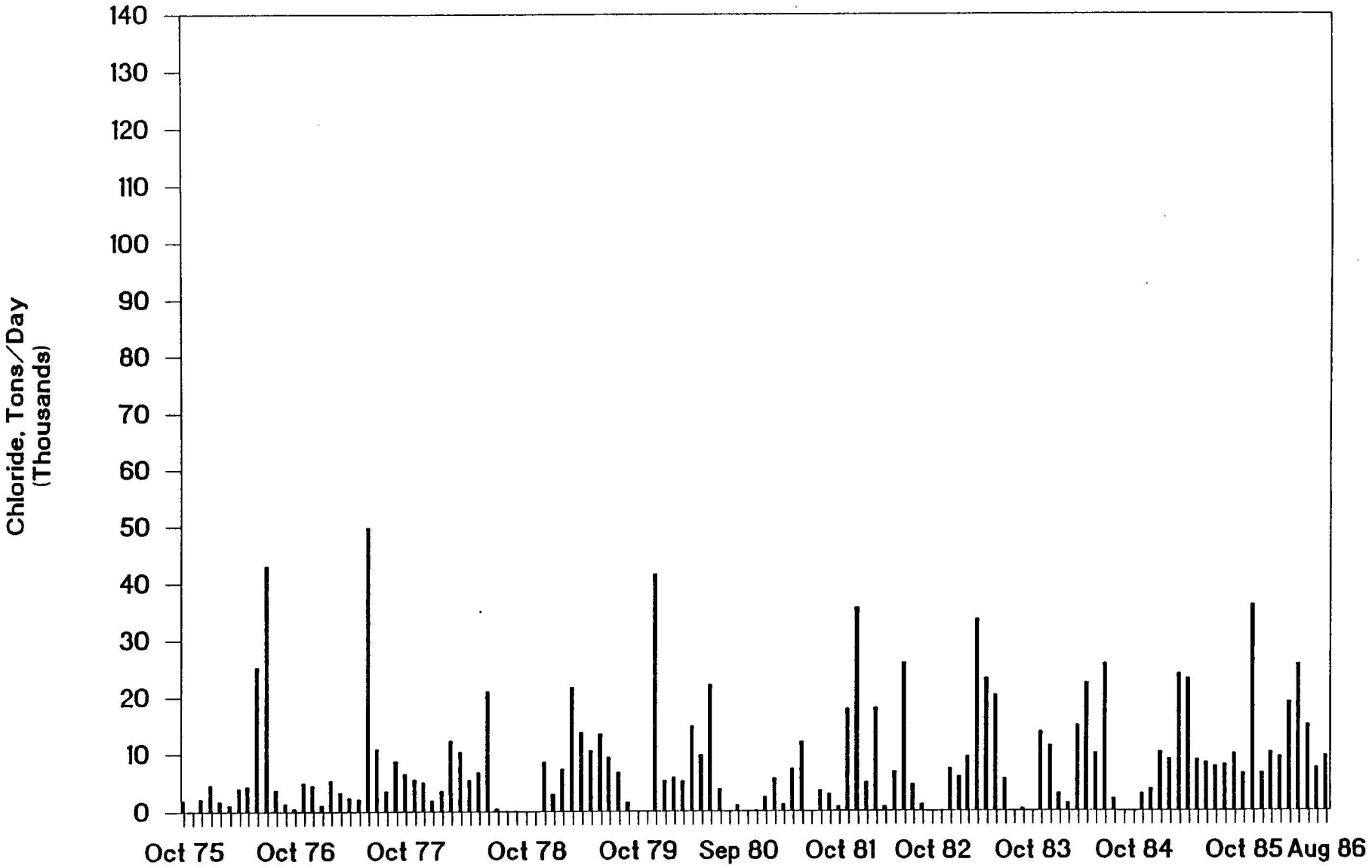

Figure 193. Graph of Chloride (Tons per Day) Versus Time For The Dardanelle Site 1974-1986.

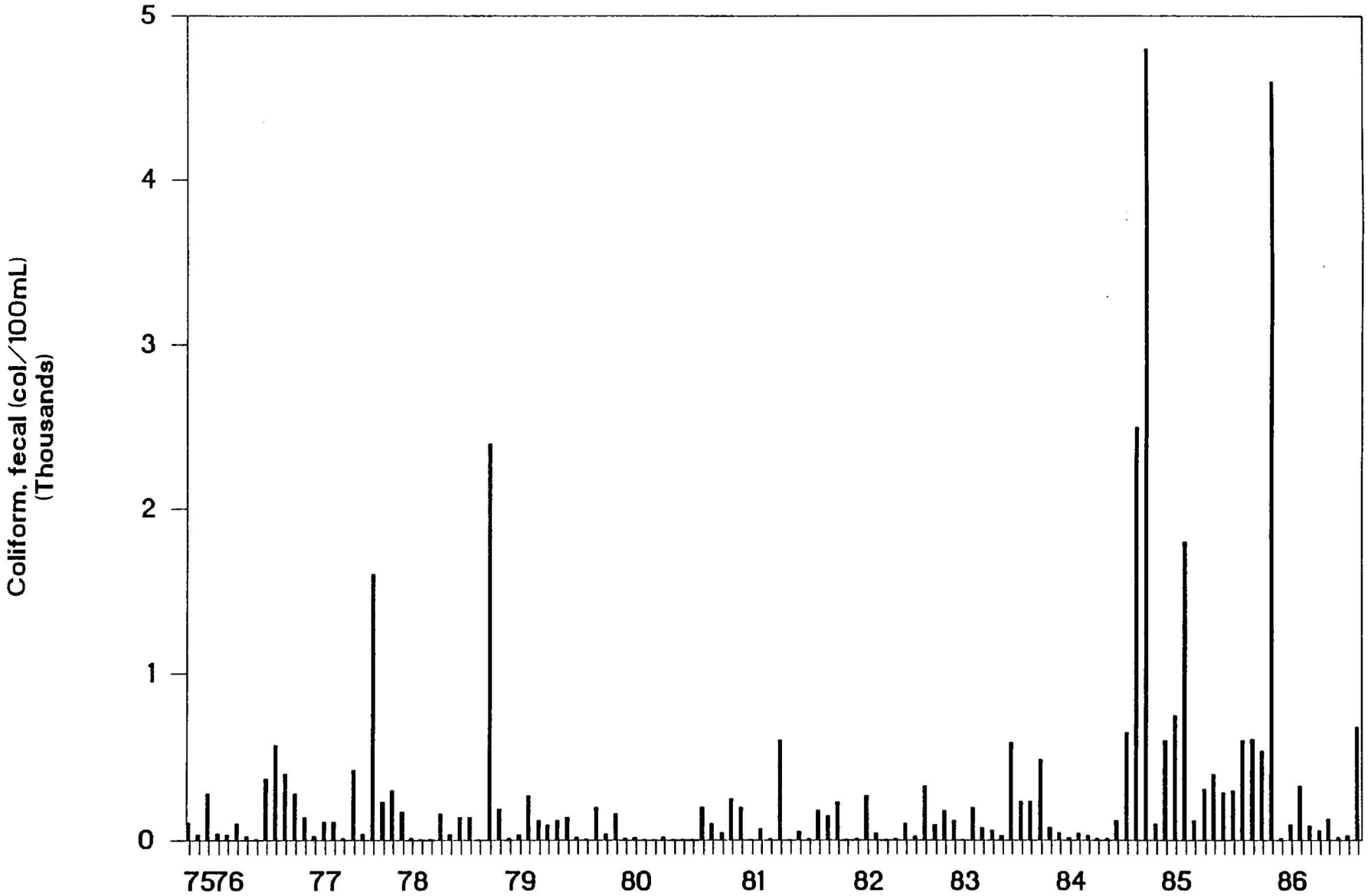

Figure 194. Graph of Coliform Versus Time For The Dardanelle Site 1974-1986.

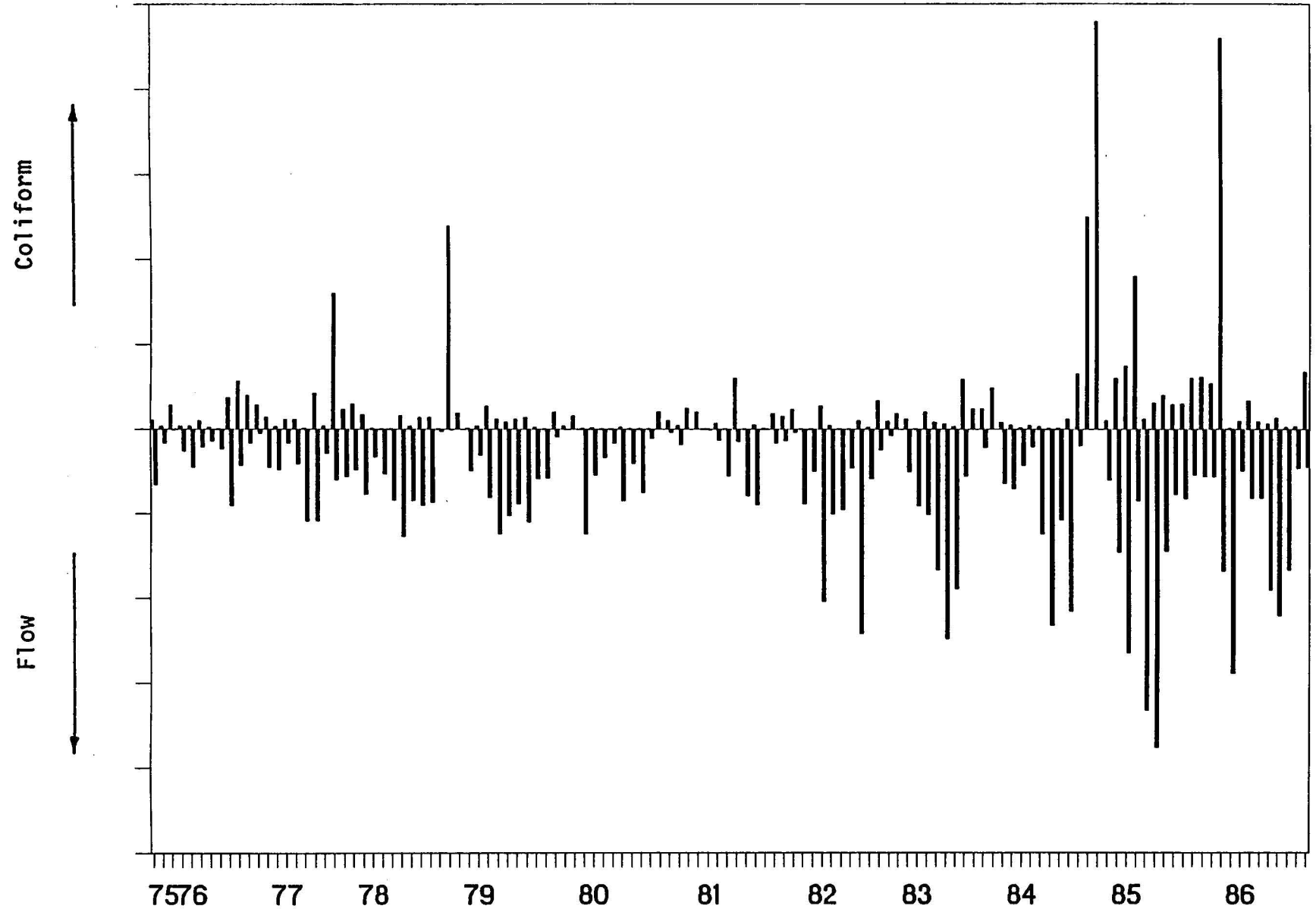

Figure 195. Graph of Coliform And Flow Versus Time For The Dardanelle Site 1974-1986.

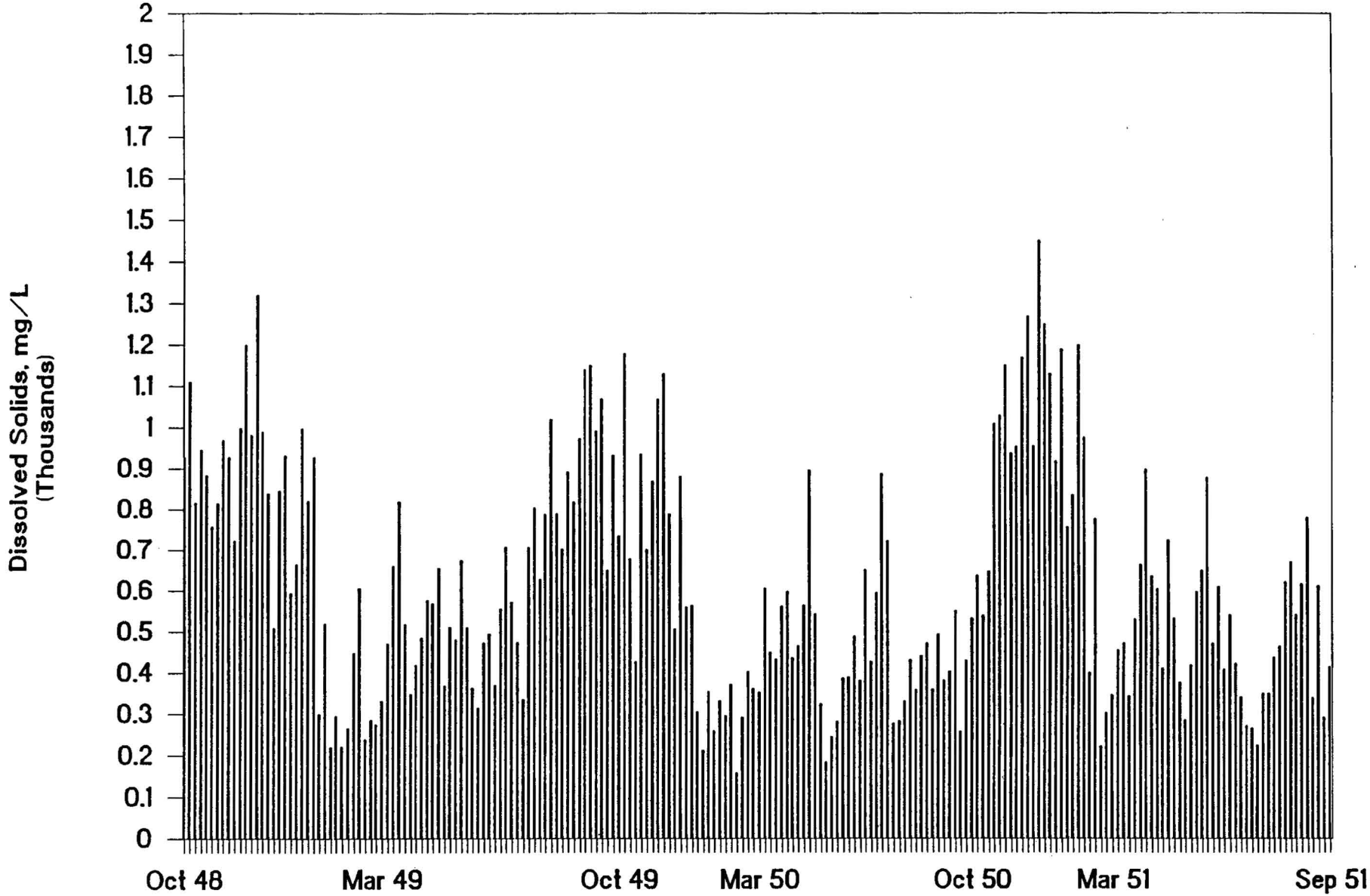

Figure 196. Graph of Dissolved Solids Versus Time For The Dardanelle Site 1948-1951.

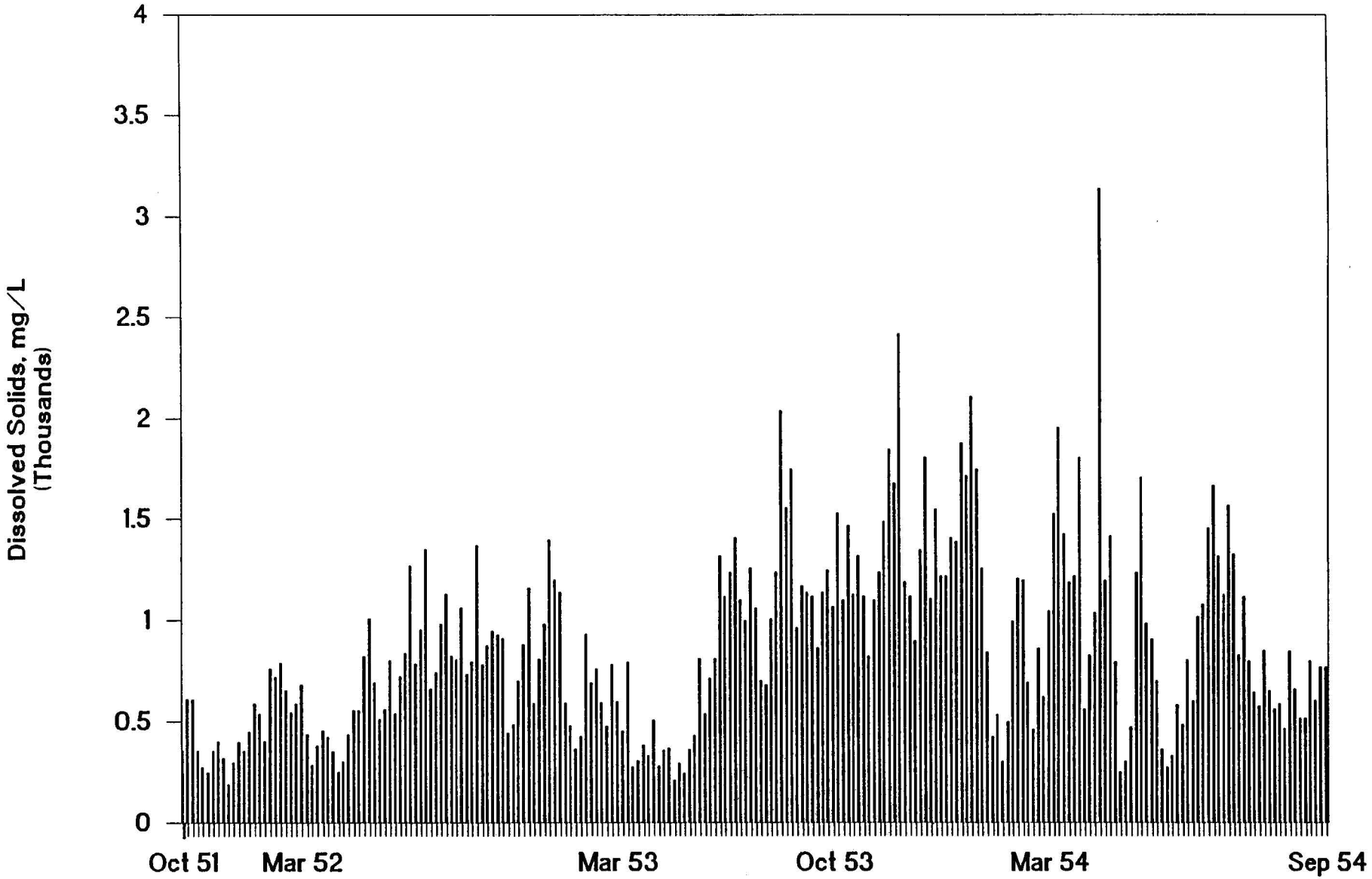

Figure 197. Graph of Dissolved Solids Versus Time For The Dardanelle Site 1951-1954.

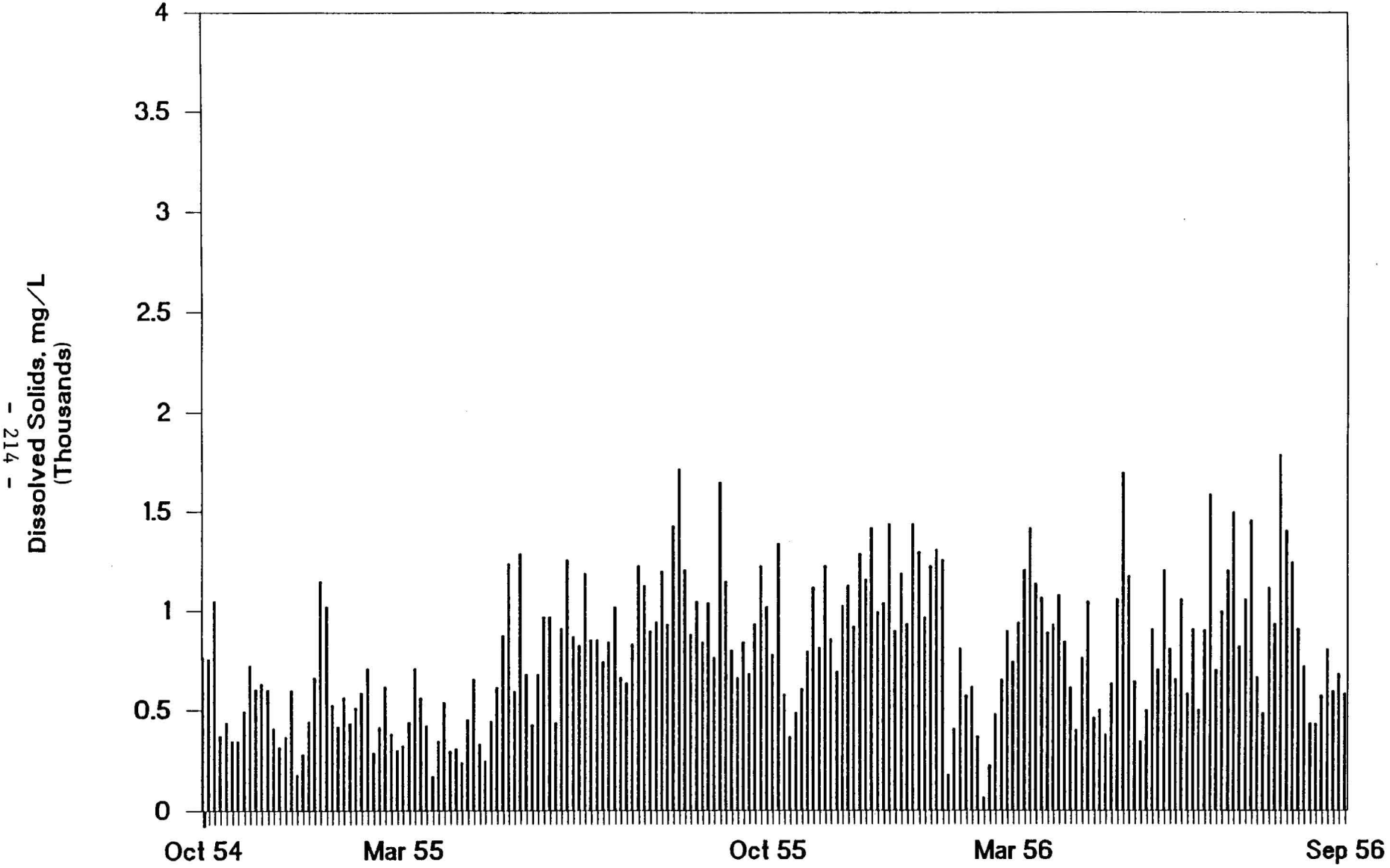

Figure 198. Graph of Dissolved Solids Versus Time For The Dardanelle Site 1954-1956.

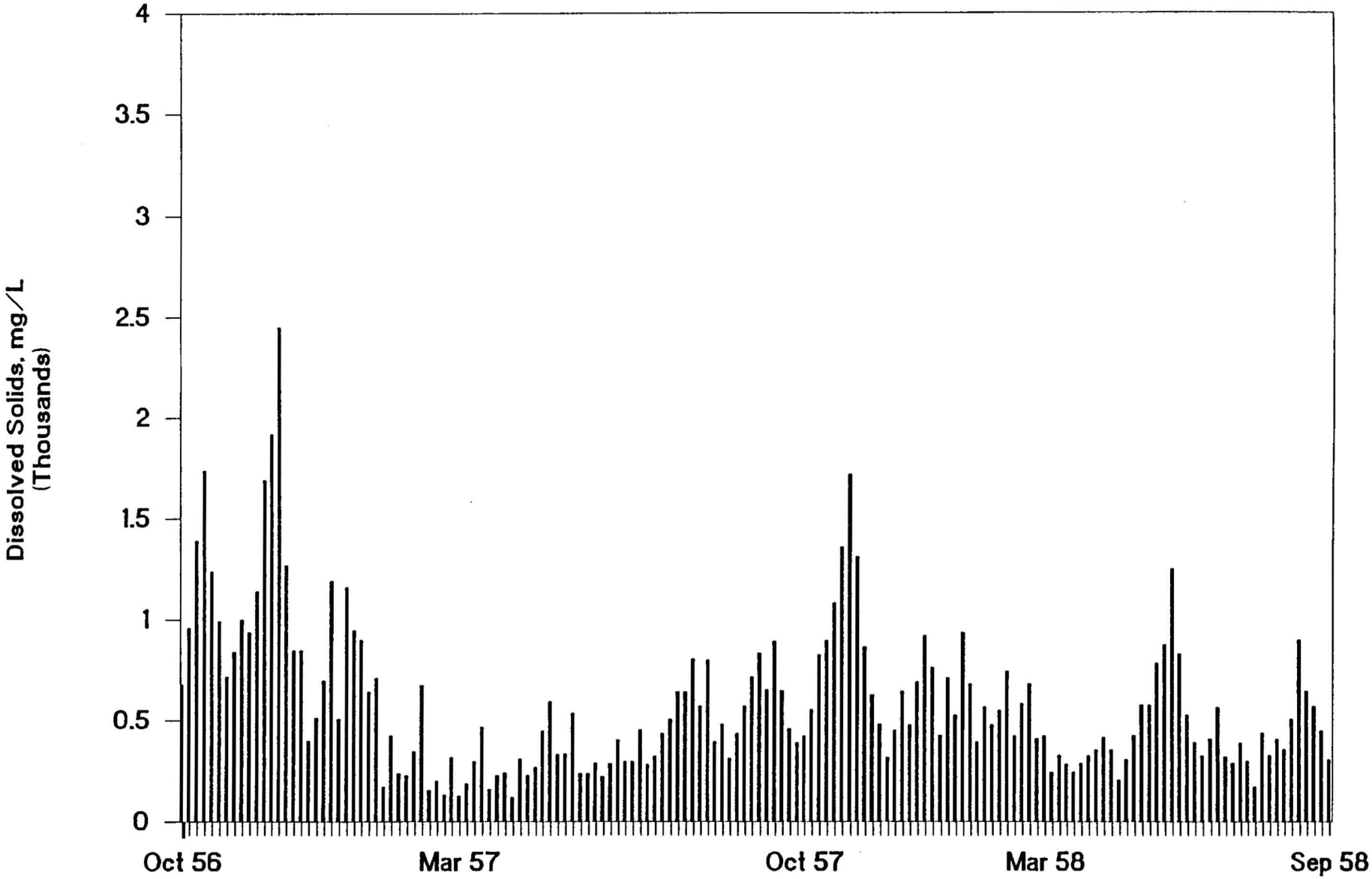

Figure 199. Graph of Dissolved Solids Versus Time For The Dardanelle Site 1956-1958.

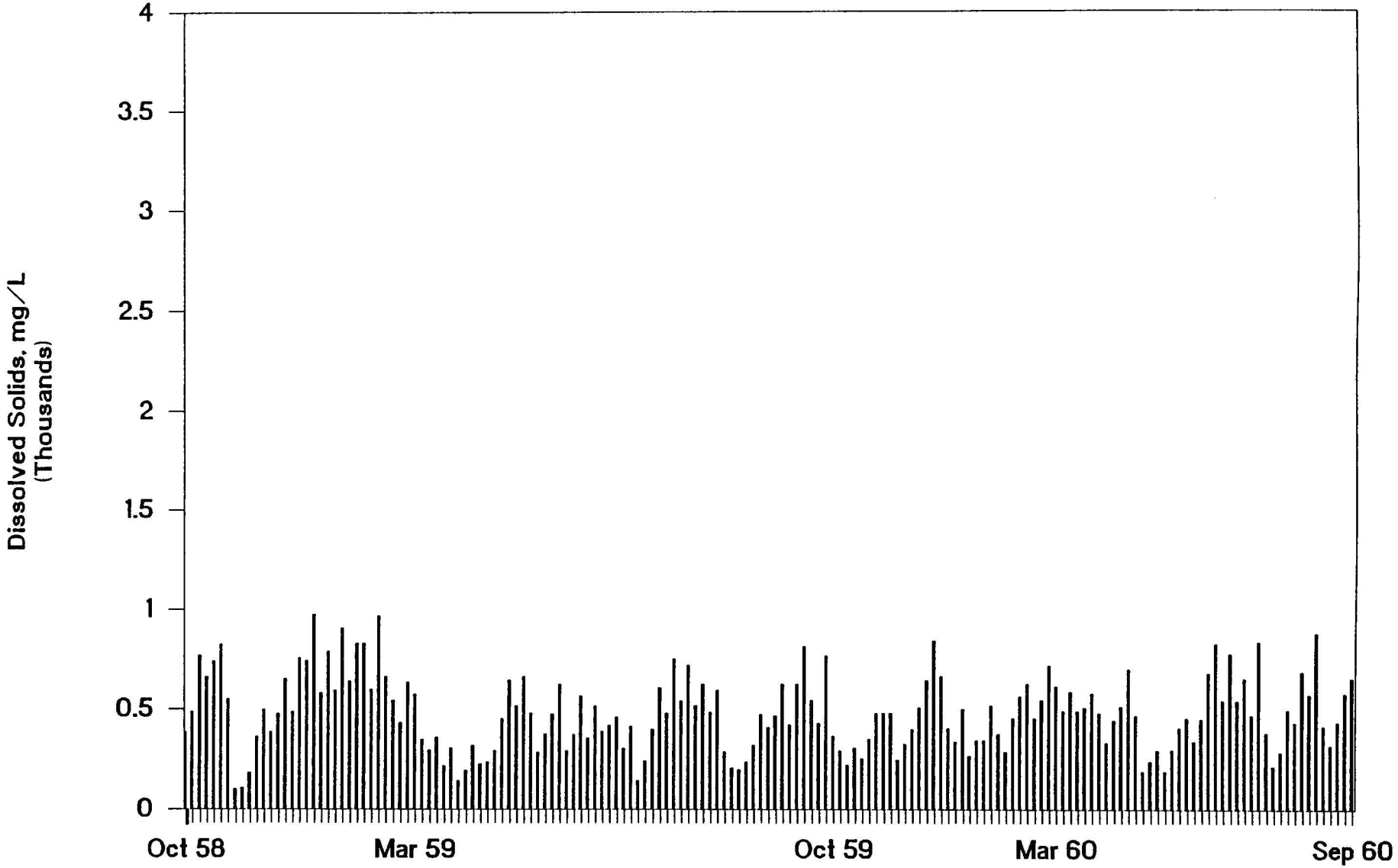

Figure 200. Graph of Dissolved Solids Versus Time For The Dardanelle Site 1958-1960.

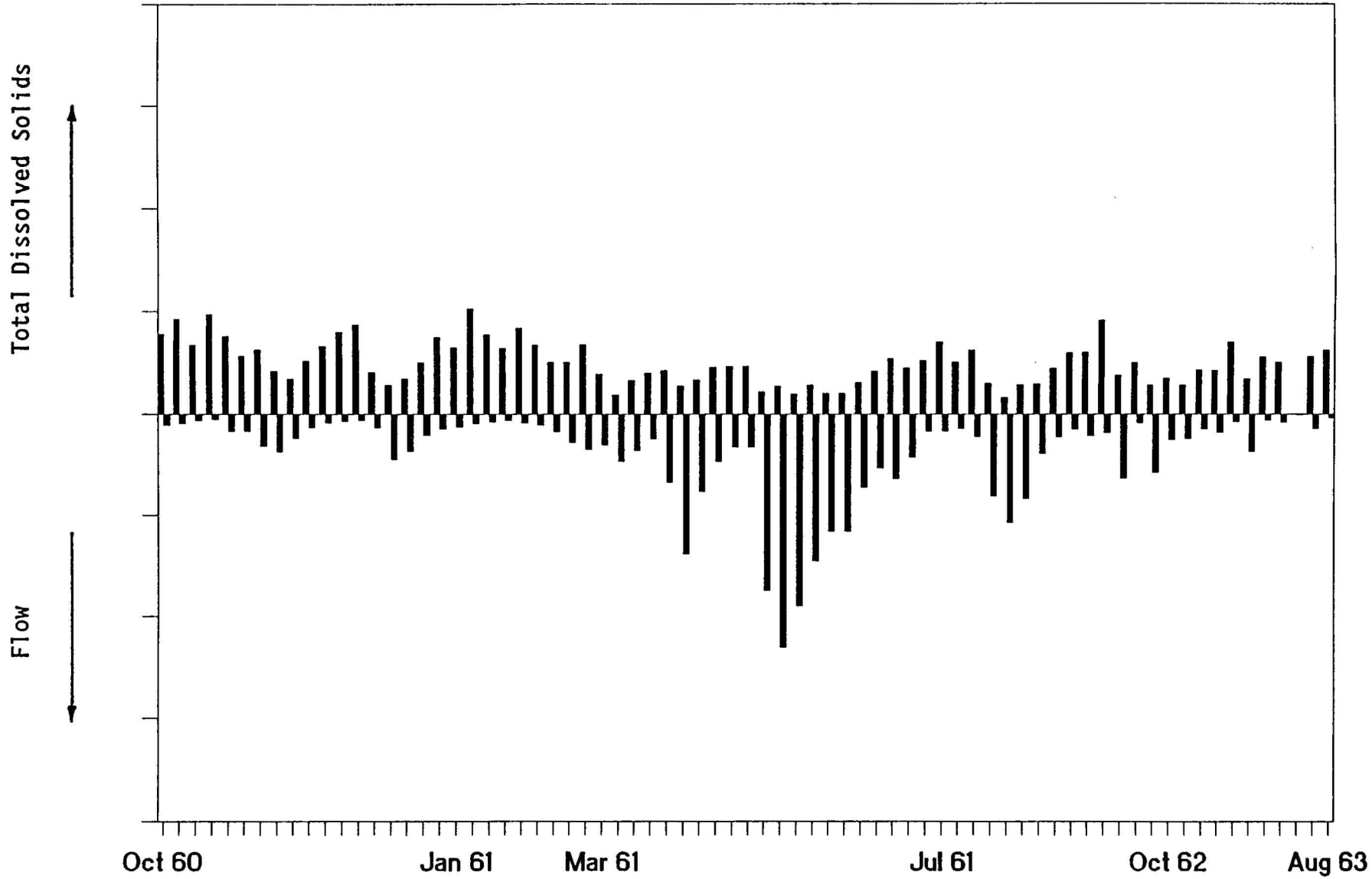

Figure 201. Graph of Dissolved Solids Versus Time For The Dardanelle Site 1960-1963.

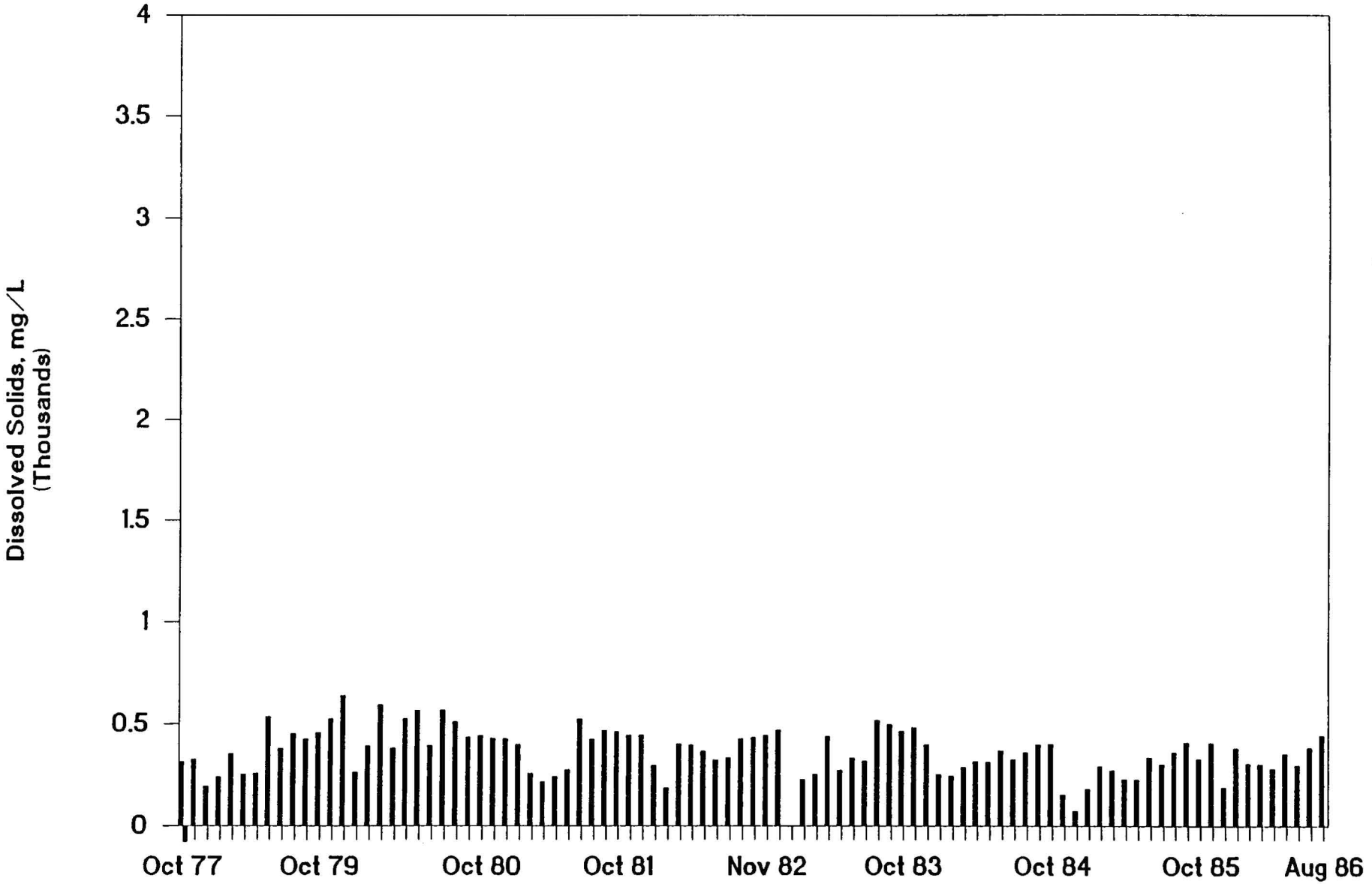

Figure 202. Graph of Dissolved Solids Versus Time For The Dardanelle Site 1977-1986.

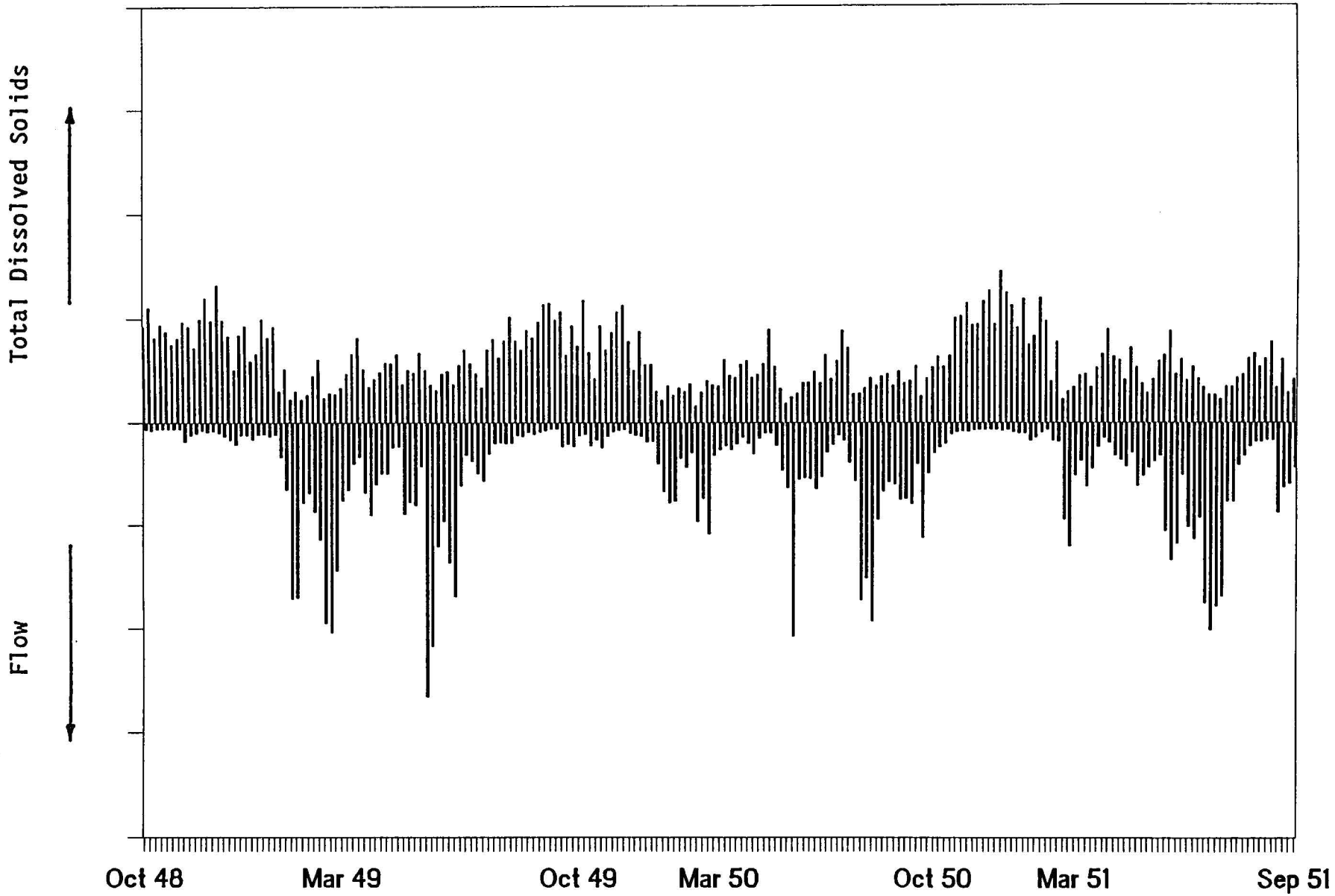

Figure 203. Graph of Dissolved Solids And Flow Versus Time For The Dardanelle Site 1948-1951.

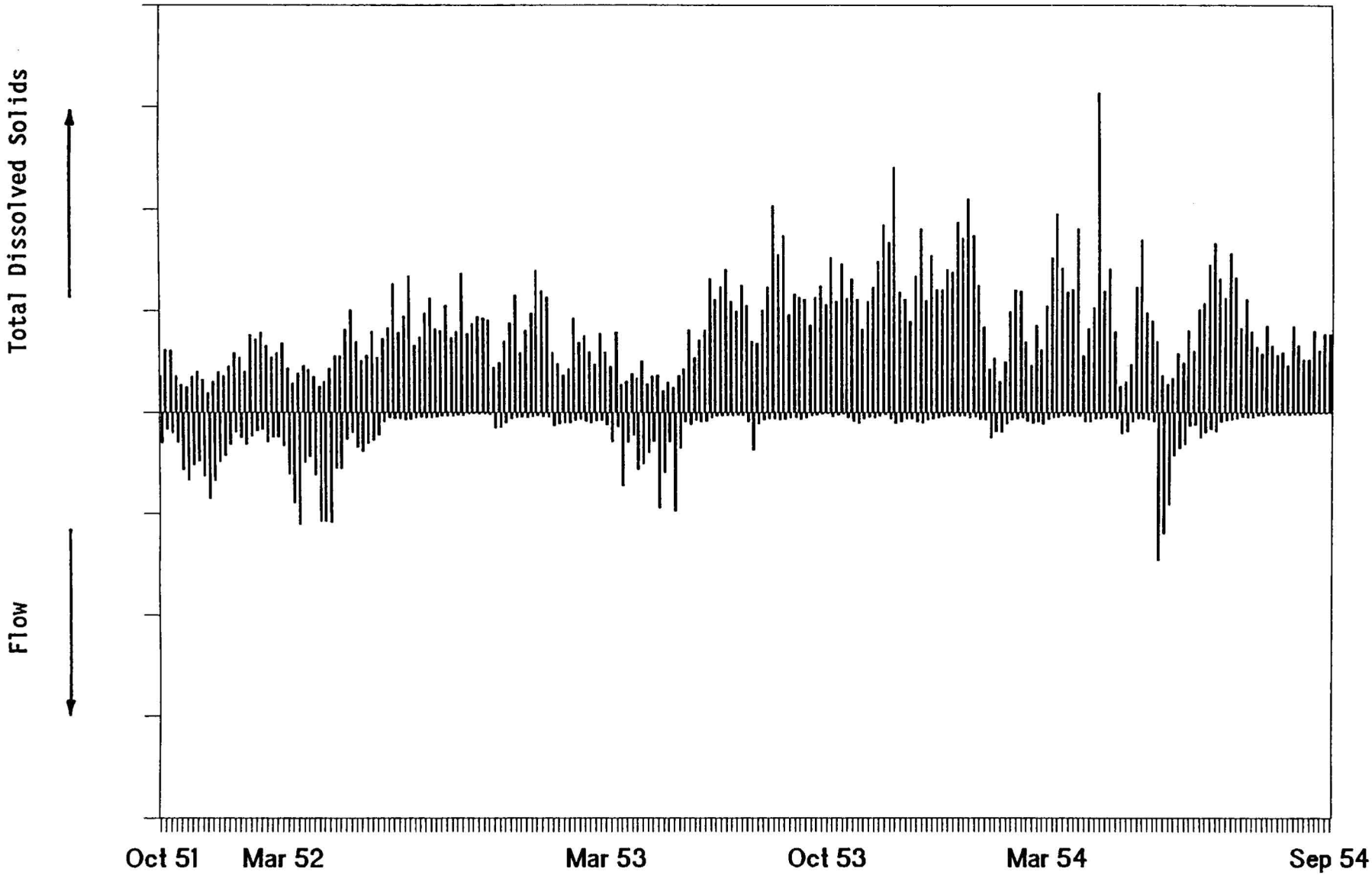

Figure 204. Graph of Dissolved Solids And Flow Versus Time For The Dardanelle Site 1951-1954.

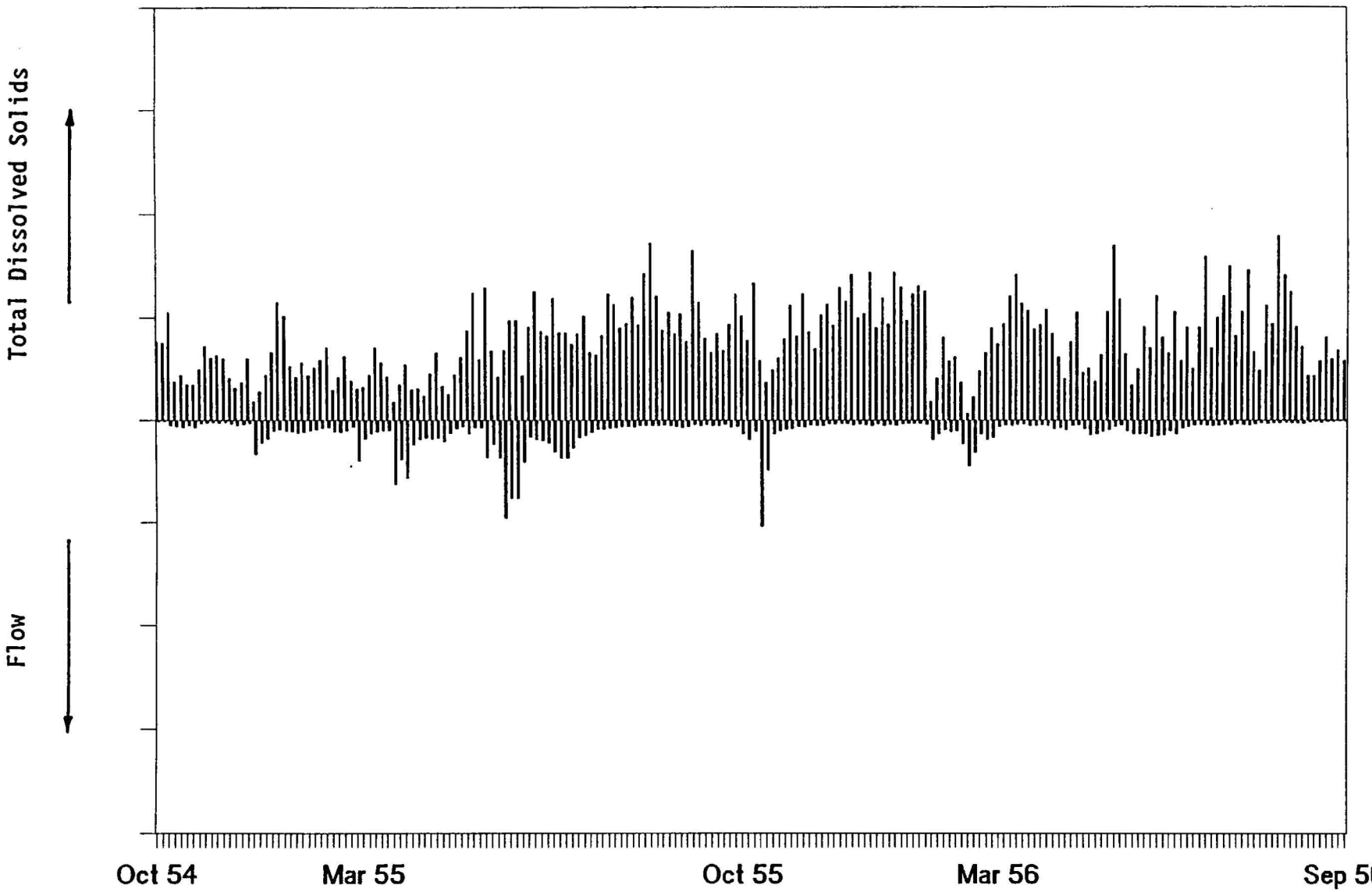

Figure 205. Graph of Dissolved Solids And Flow Versus Time For The Dardanelle Site 1954-1956.

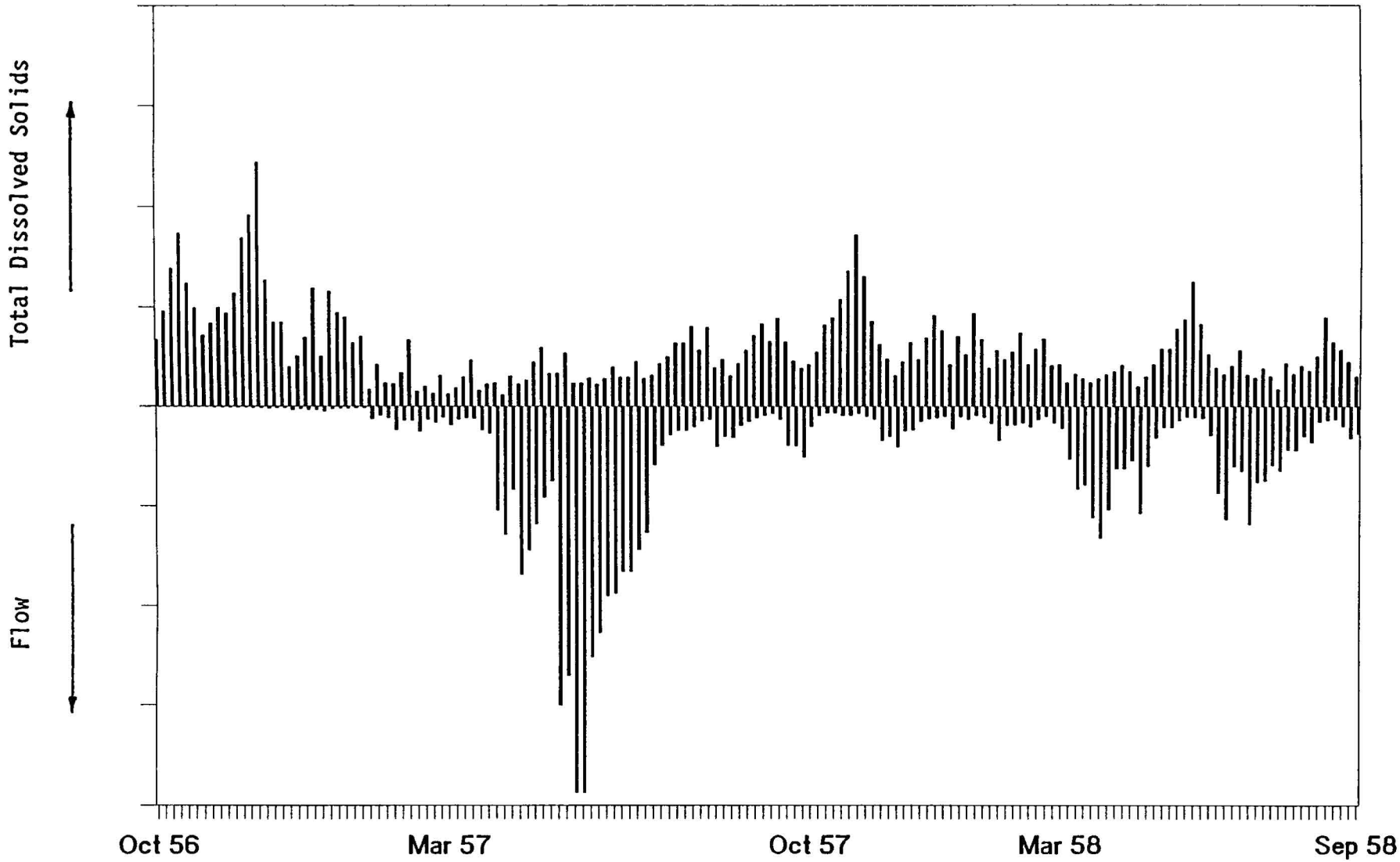

Figure 206. Graph of Dissolved Solids And Flow Versus Time For The Dardanelle Site 1956-1958.

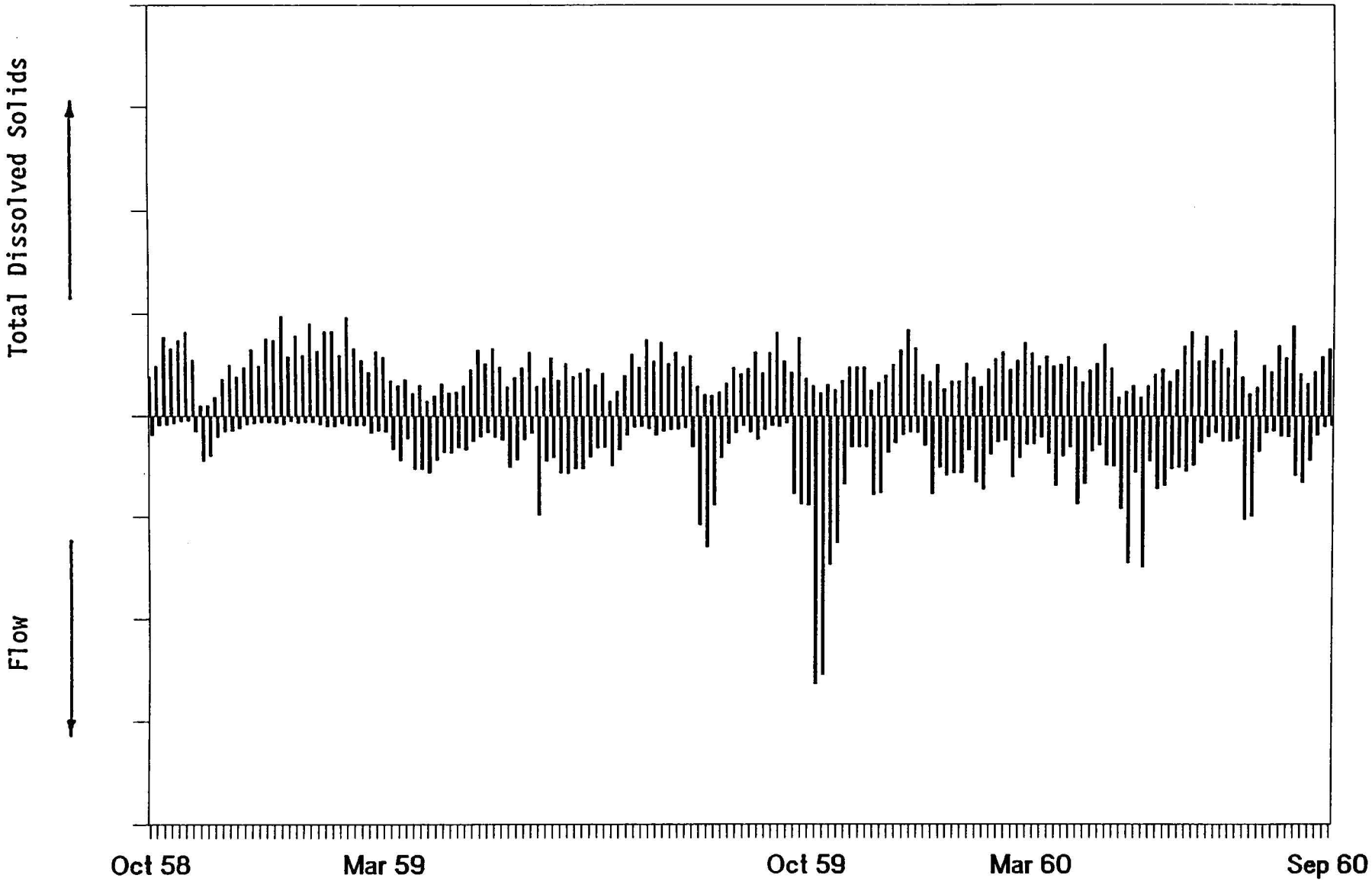

Figure 207. Graph of Dissolved Solids And Flow Versus Time For The Dardanelle Site 1958-1960.

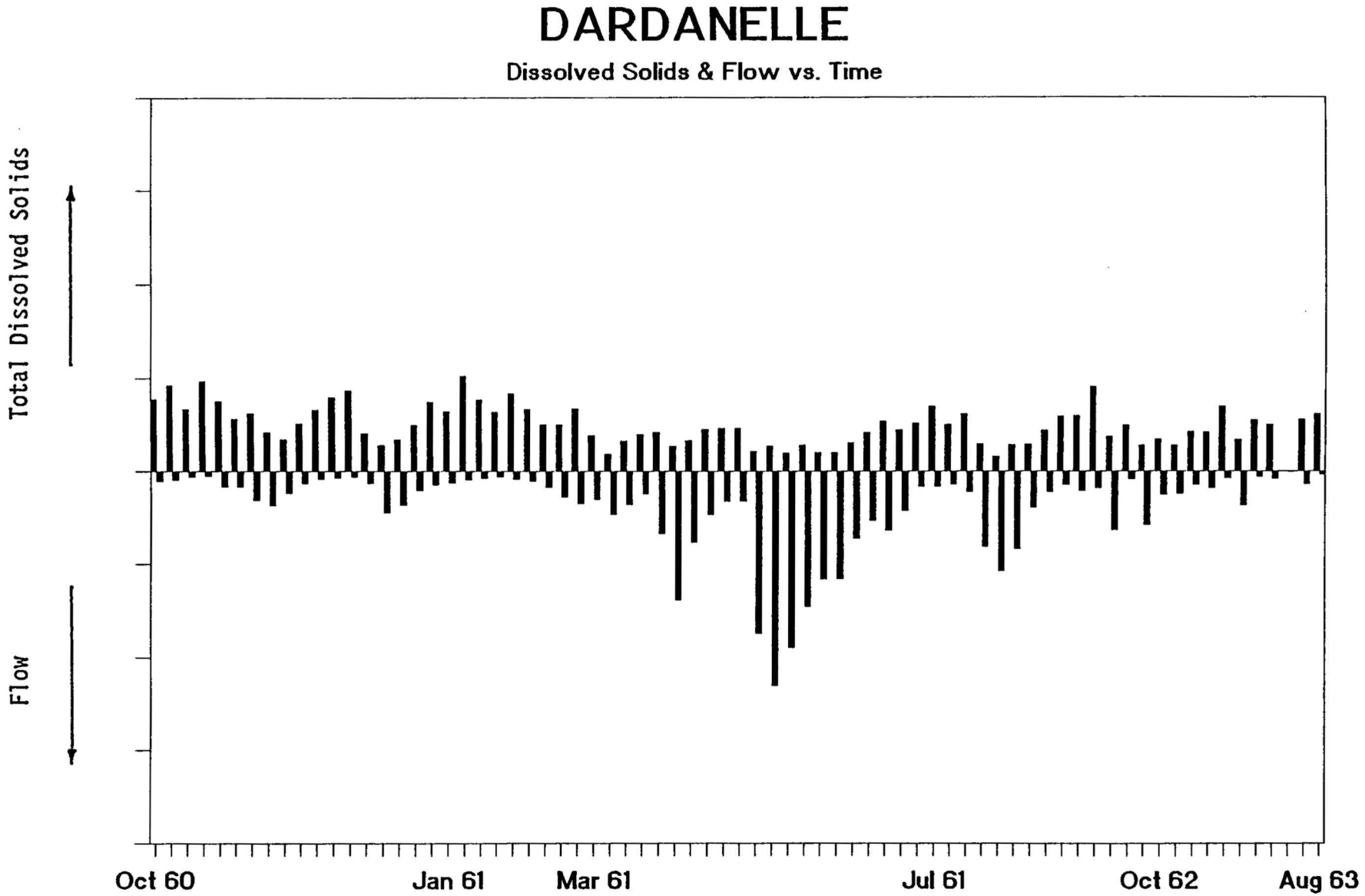

Figure 208. Graph of Dissolved Solids And Flow Versus Time For The Dardanelle Site 1960-1963.

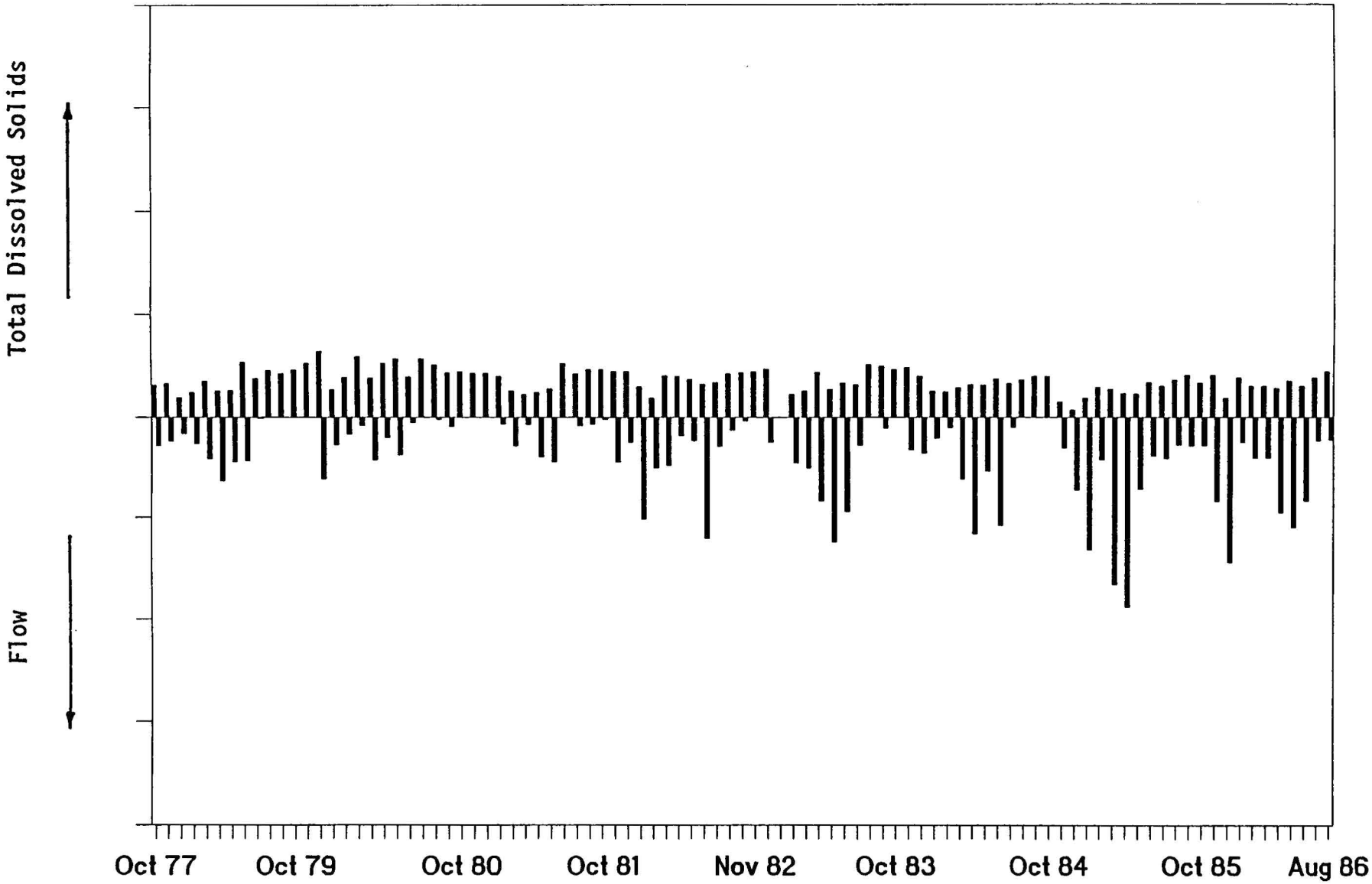

Figure 209. Graph of Dissolved Solids And Flow Versus Time For The Dardanelle Site 1977-1986.

pH. The average pH value was 7.7. The minimum and maximum pH values were 6.5 and 8.6, respectively. The data base included 1,071 pH values. The average pH value prior to 1963 was 7.7. The minimum and maximum pH values were 6.5 and 8.6. For the period of record from 1974 until 1986, the average pH value was 7.9. The minimum and maximum values were 7.4 and 8.6, respectively.

Potassium. The potassium concentrations ranged from 0.5 to 5 mg/L with an average concentration of 3.6 mg/L. Twenty concentrations were included in the record. The data are shown graphically in Figure 210.

Sodium. The average sodium concentration was 153 mg/L. The minimum and maximum concentrations were 10 and 852 mg/L, respectively. Nine-hundred and eighty-nine concentrations were included in the record. The sodium concentrations are shown in Figures 211 through 216 for short-term time periods from 1948 until 1963. All data for this period are shown in Figure 217. Flow and sodium are plotted as a function of time in Figures 218 through 223 for the short-term periods.

Sulfate. The overall average sulfate concentration was 56 mg/L for the entire record. The average concentration prior to 1963 was 57 mg/L. The minimum and maximum concentrations prior to 1963 were 6 and 182 mg/L, respectively. The record included 1,028 concentrations. The average concentration for the period of record after 1974 was 46 mg/L. The minimum and maximum concentrations after 1974 were 17 and 82 mg/L, respectively. The sulfate data are plotted in Figures 224 through 229 for two and three year cycles from 1948

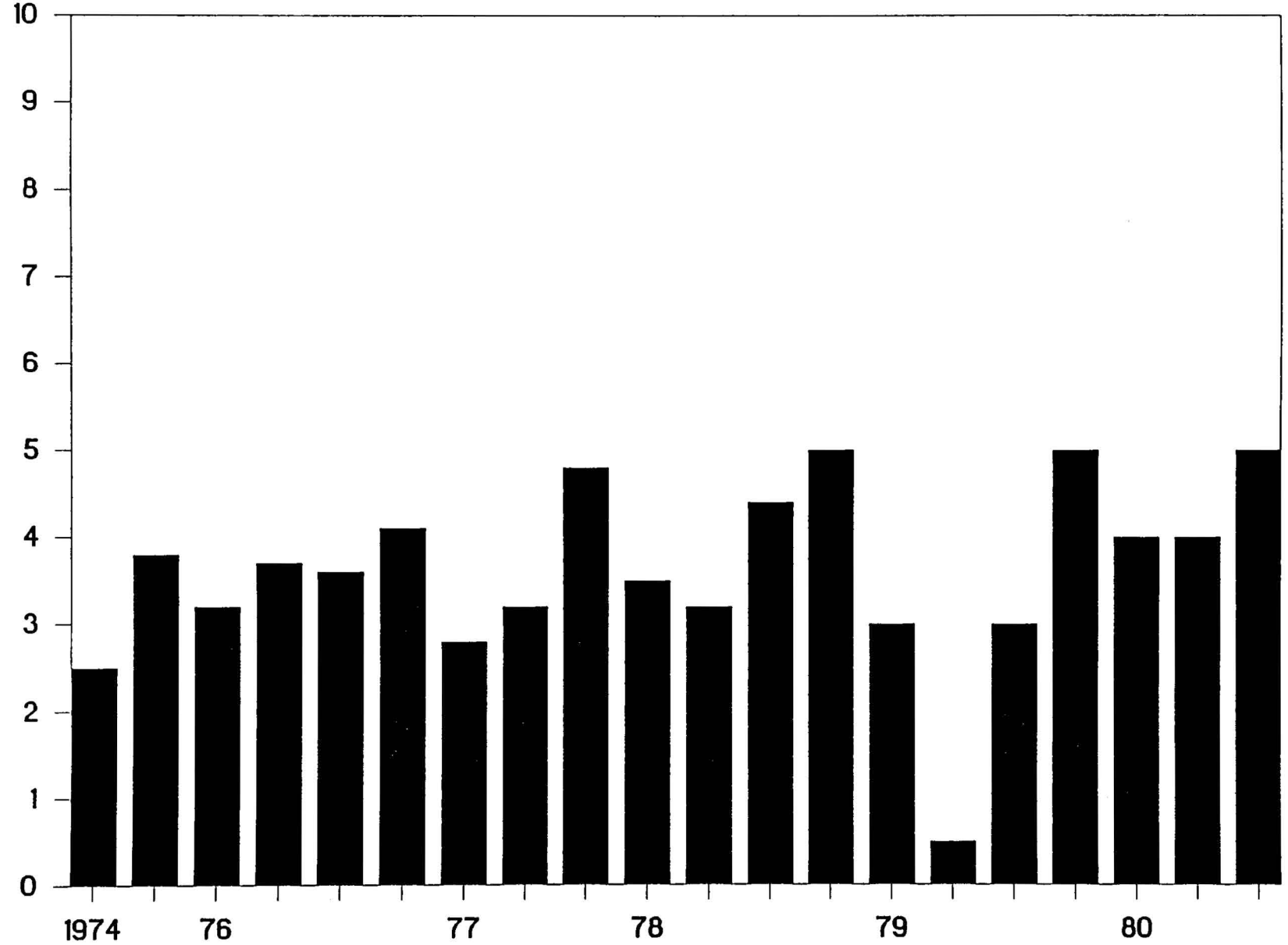

Figure 210. Graph of Potassium Versus Time For The Dardanelle Site 1974-1981.

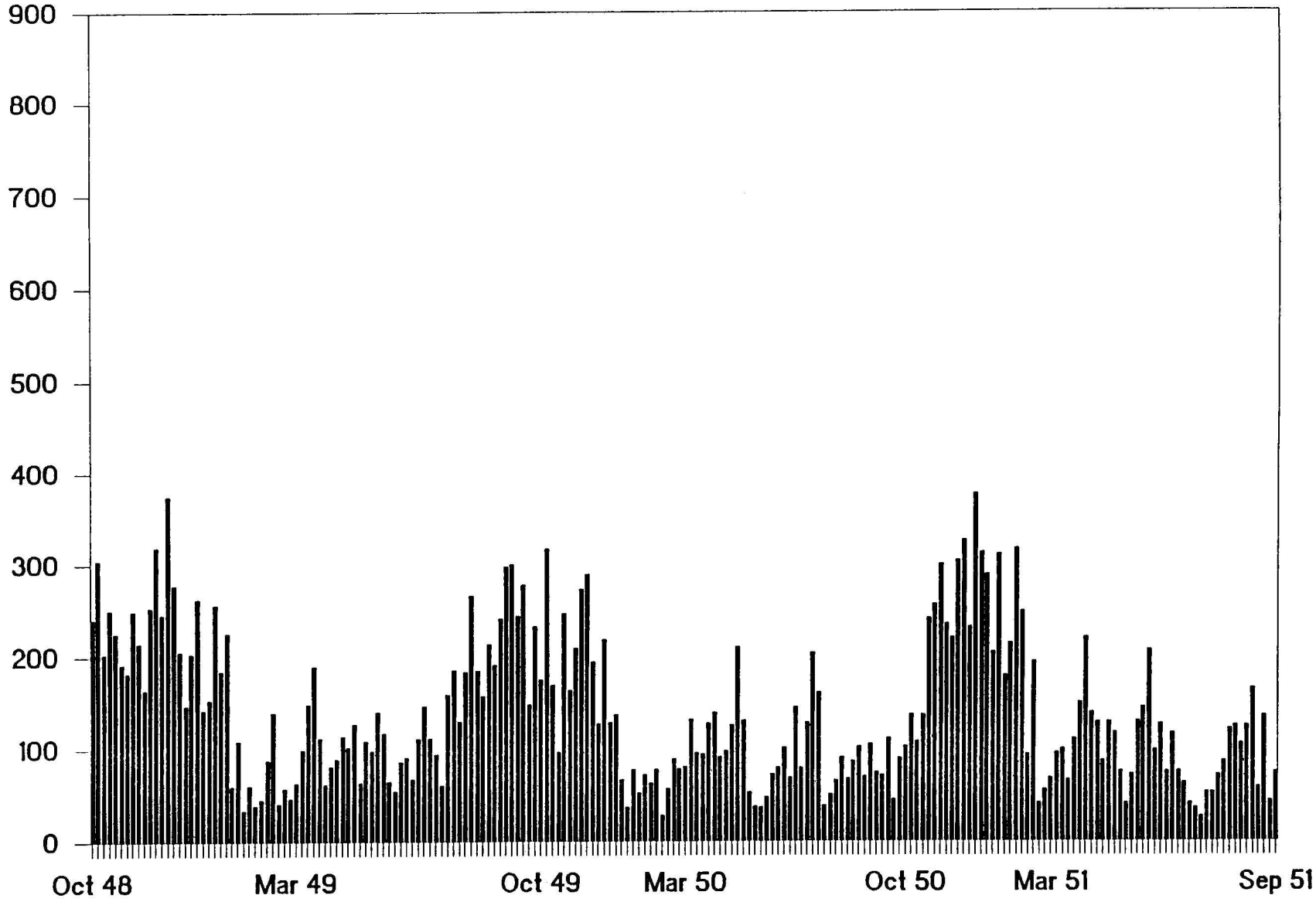

Figure 211. Graph of Sodium Versus Time For The Dardanelle Site 1948-1951.

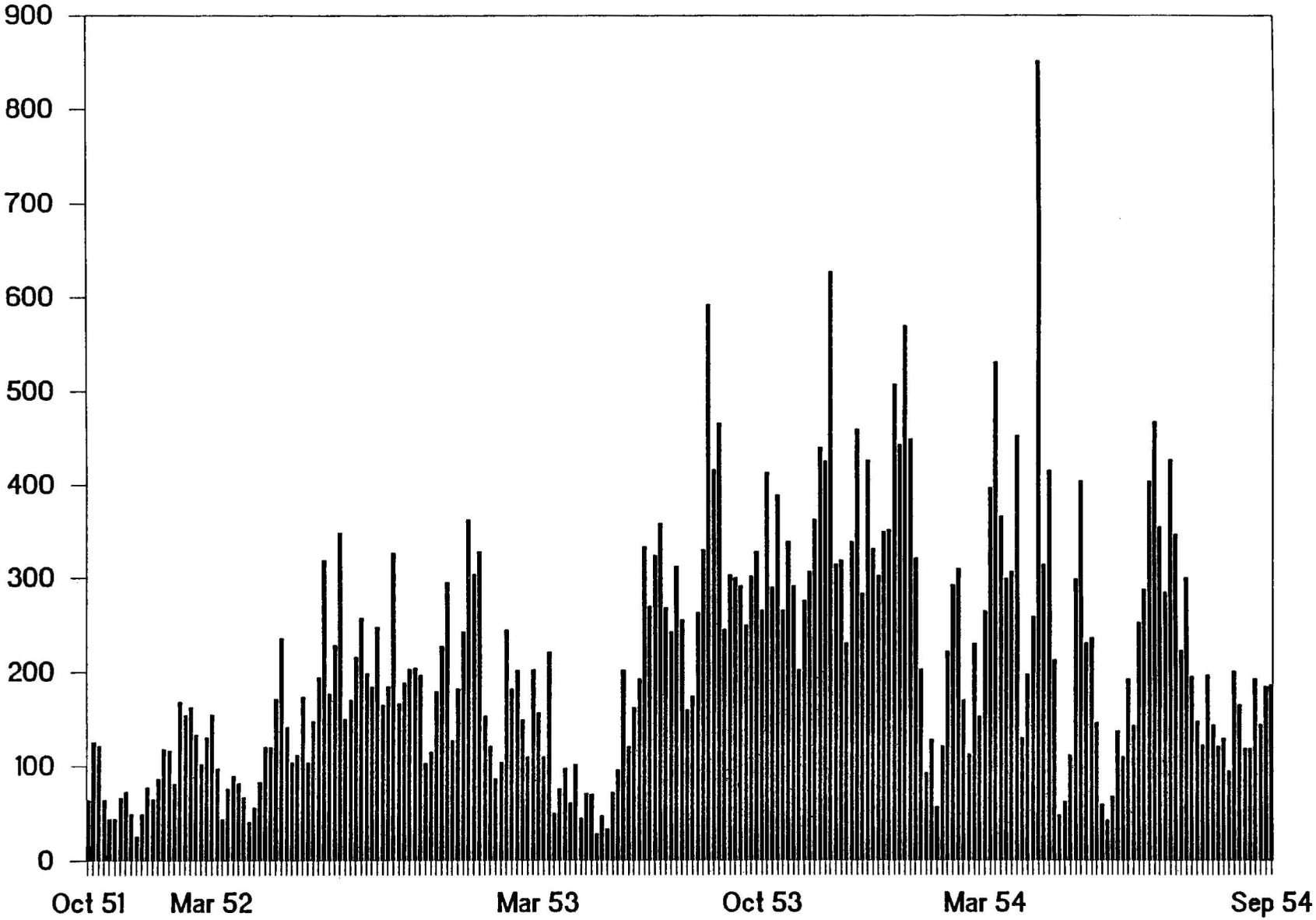

Figure 212. Graph of Sodium Versus Time For The Dardanelle Site 1951-1954.

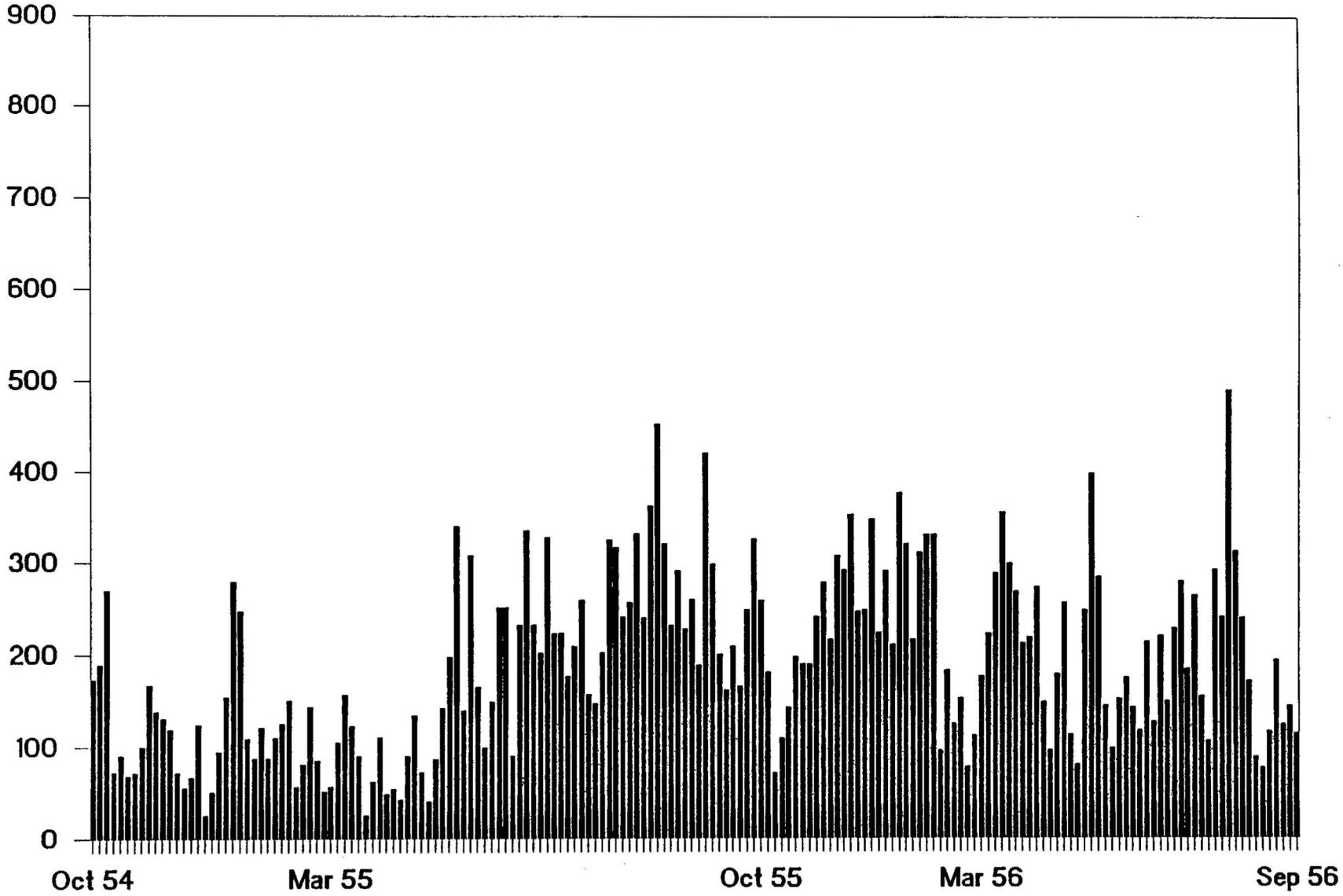

Figure 213. Graph of Sodium Versus Time For The Dardanelle Site 1954-1956.

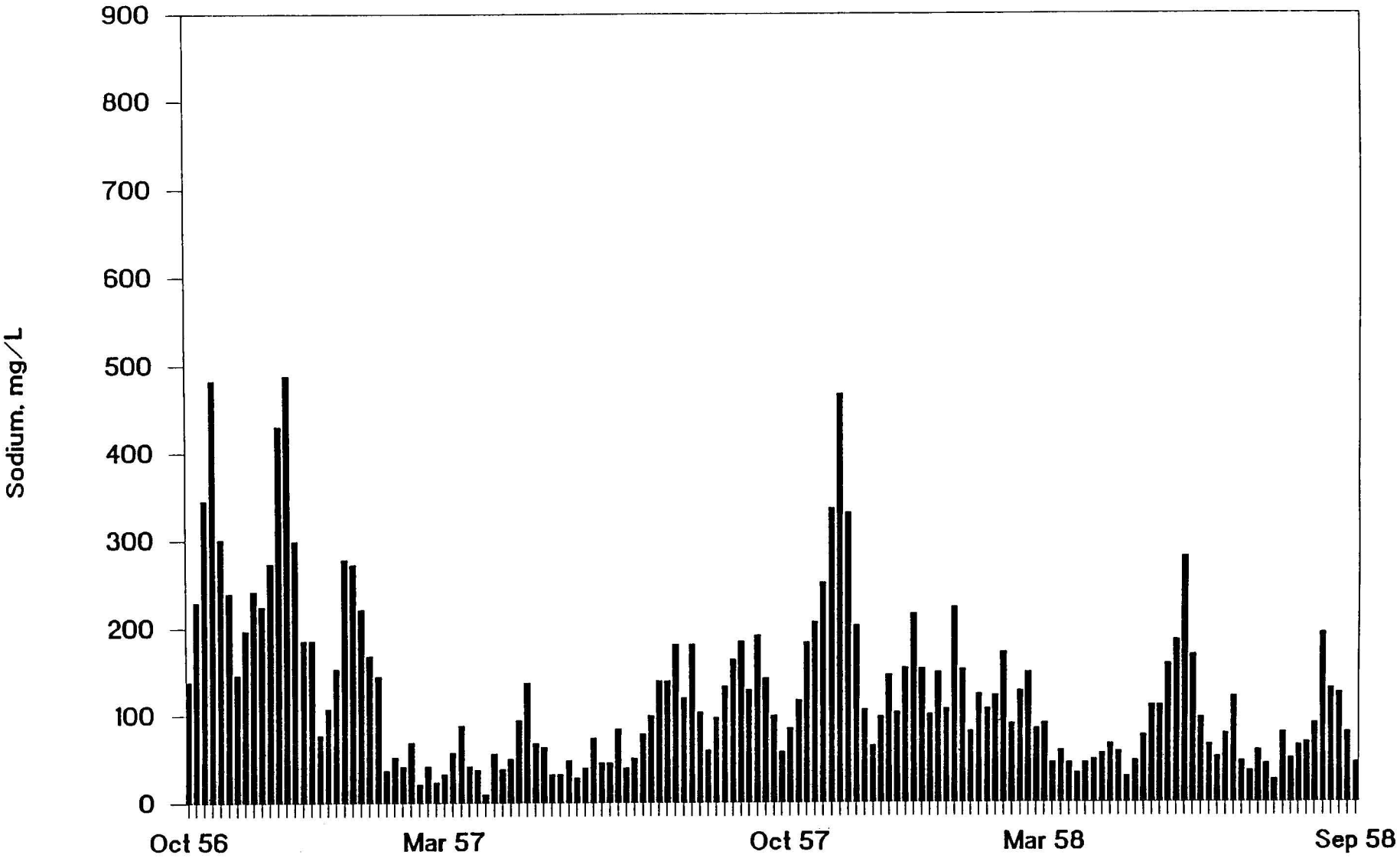

Figure 214. Graph of Sodium Versus Time For The Dardanelle Site 1956-1958.

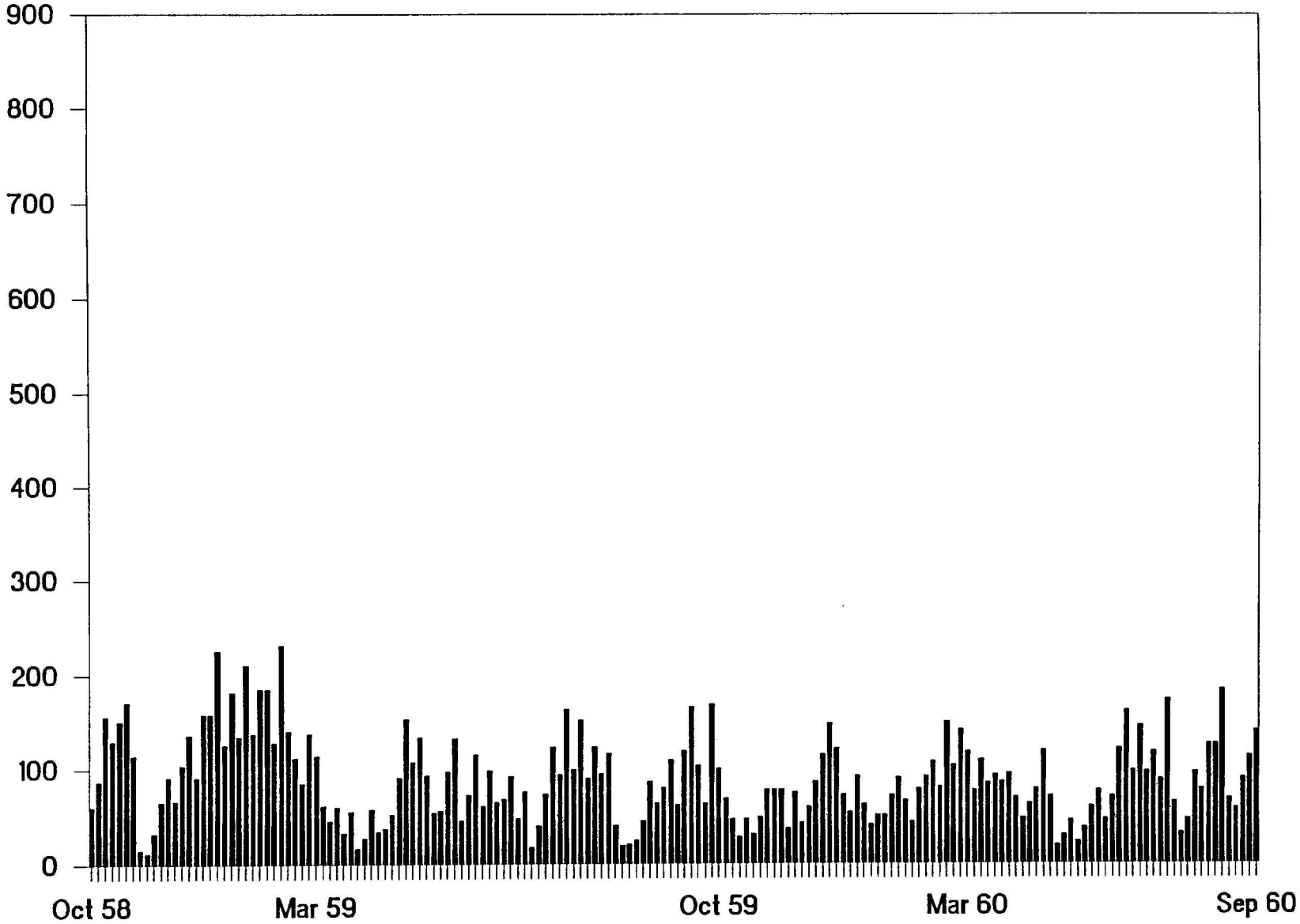

Figure 215. Graph of Sodium Versus Time For The Dardanelle Site 1958-1960.

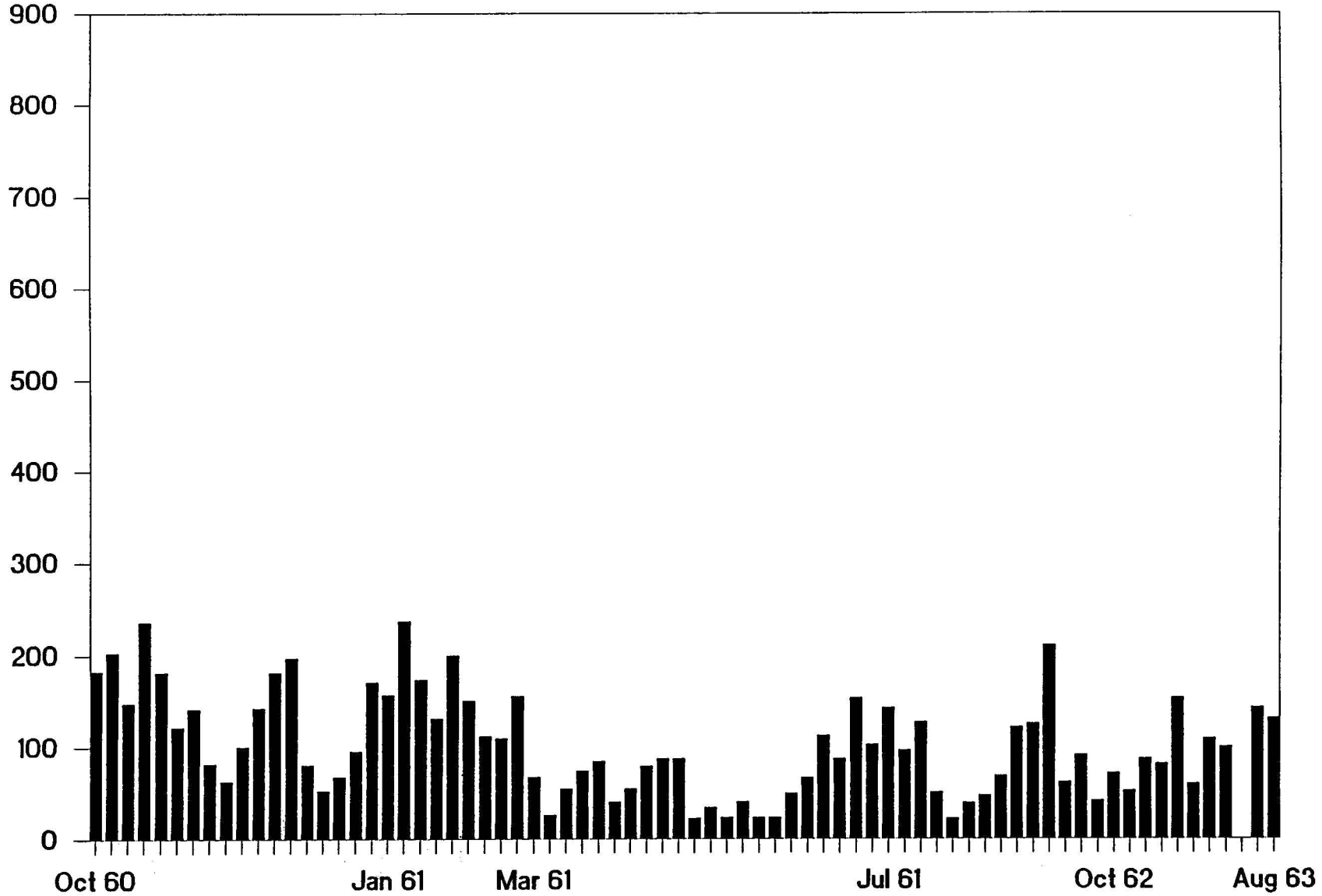

Figure 216. Graph of Sodium Versus Time For The Dardanelle Site 1960-1963.

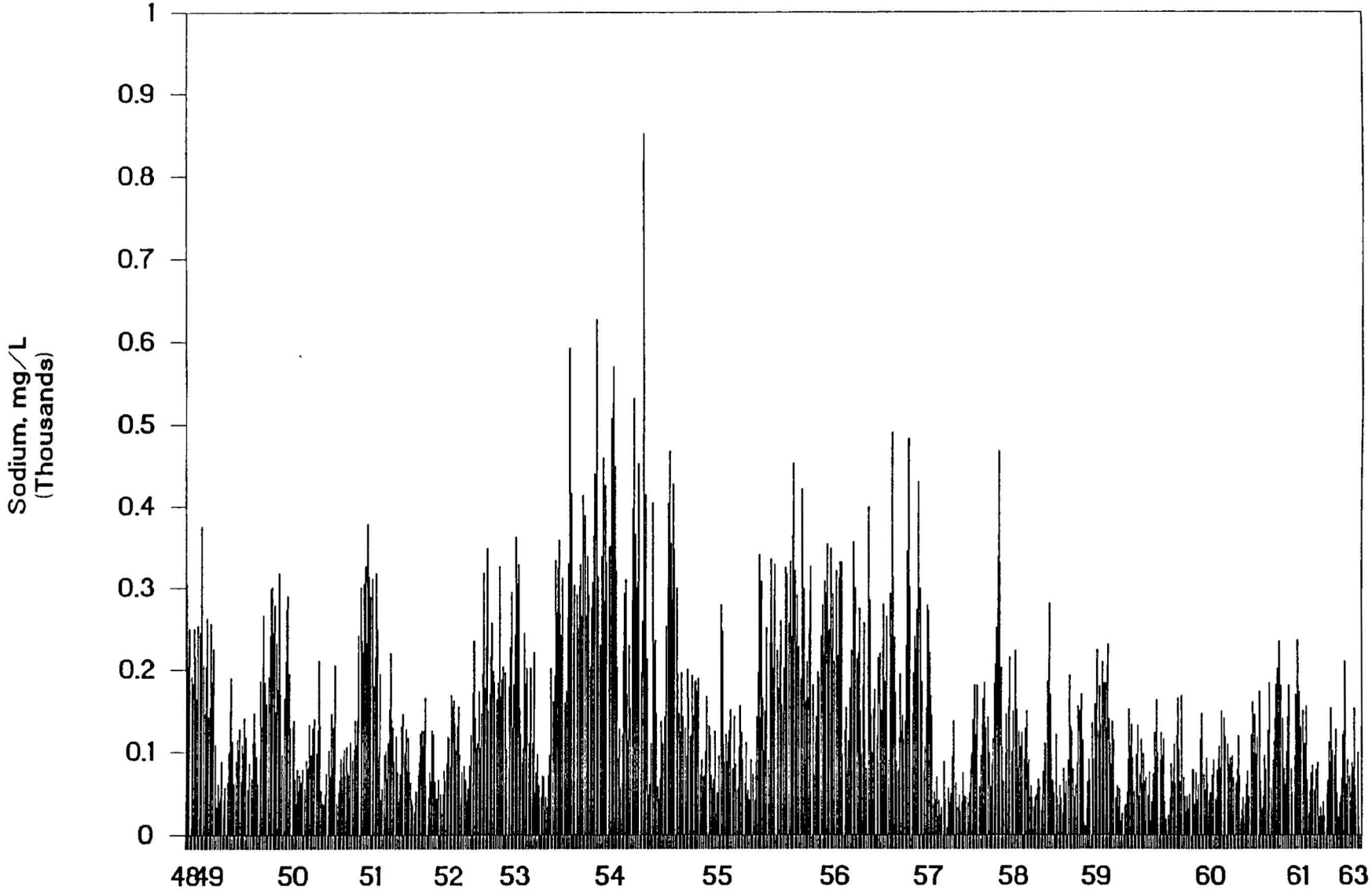

Figure 217. Graph of Sodium Versus Time For The Dardanelle Site 1948-1963.

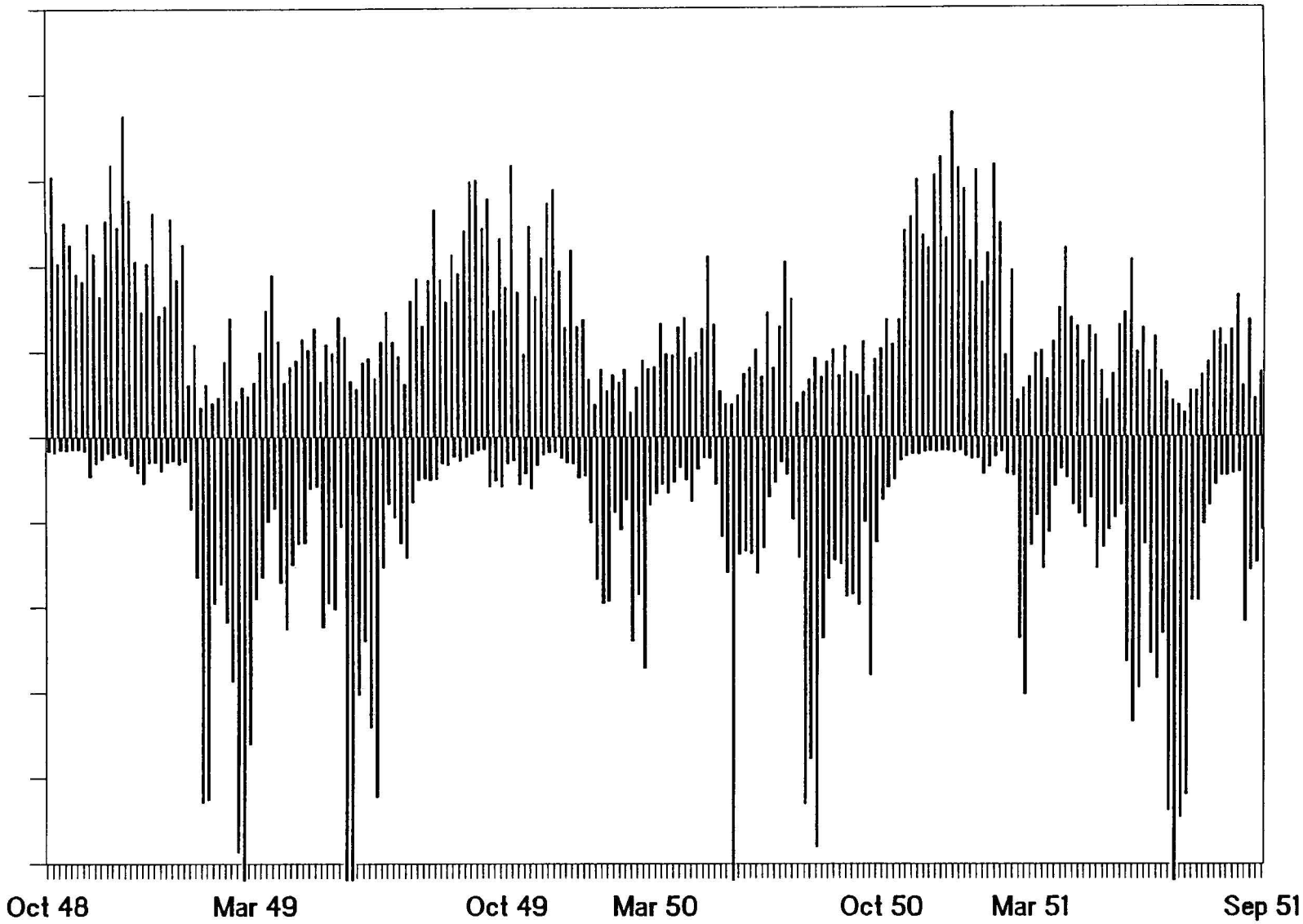

Figure 218. Graph of Sodium And Flow Versus Time For The Dardanelle Site 1948-1951.

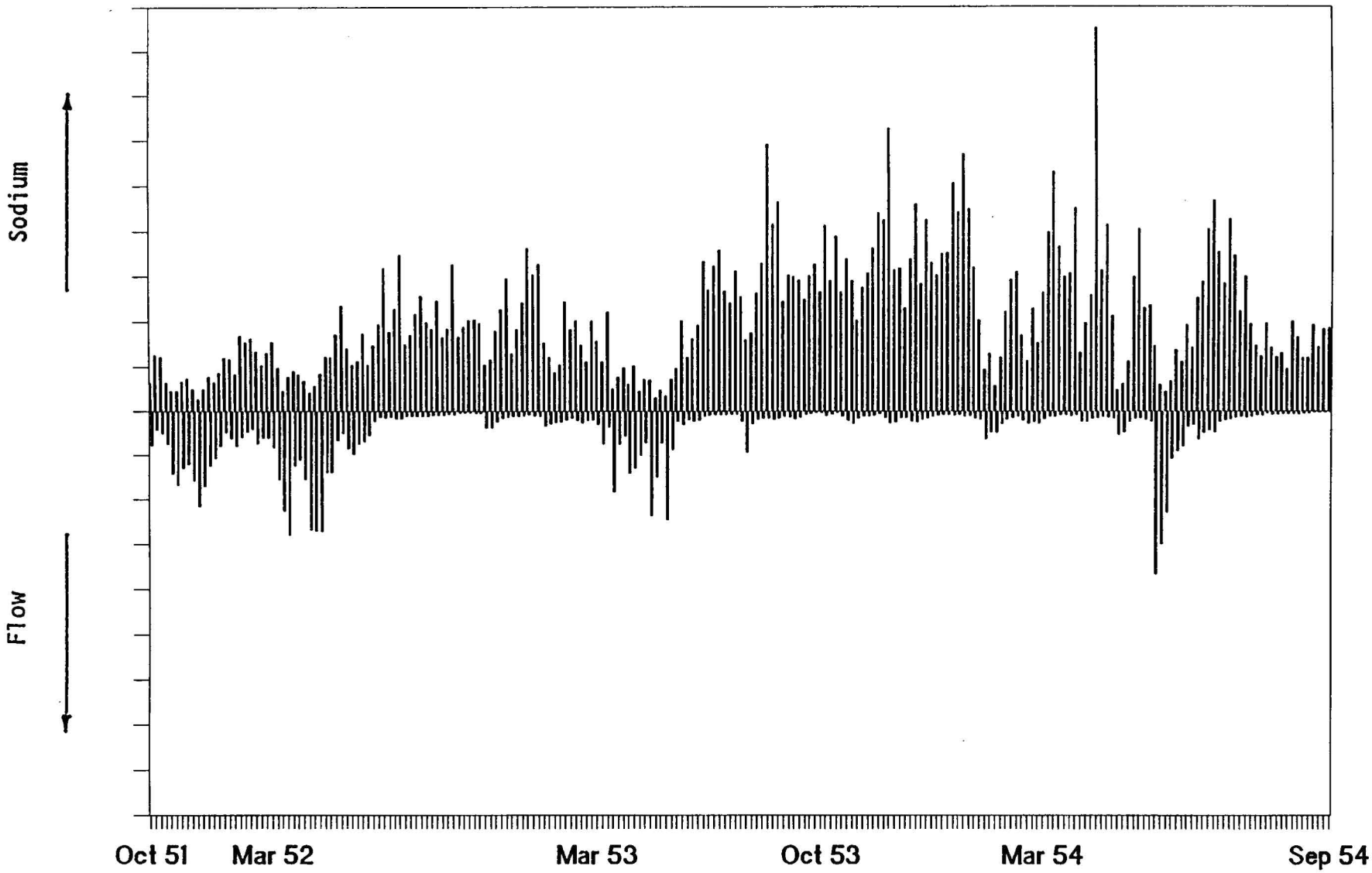

Figure 219. Graph of Sodium And Flow Versus Time For The Dardanelle Site 1951-1954.

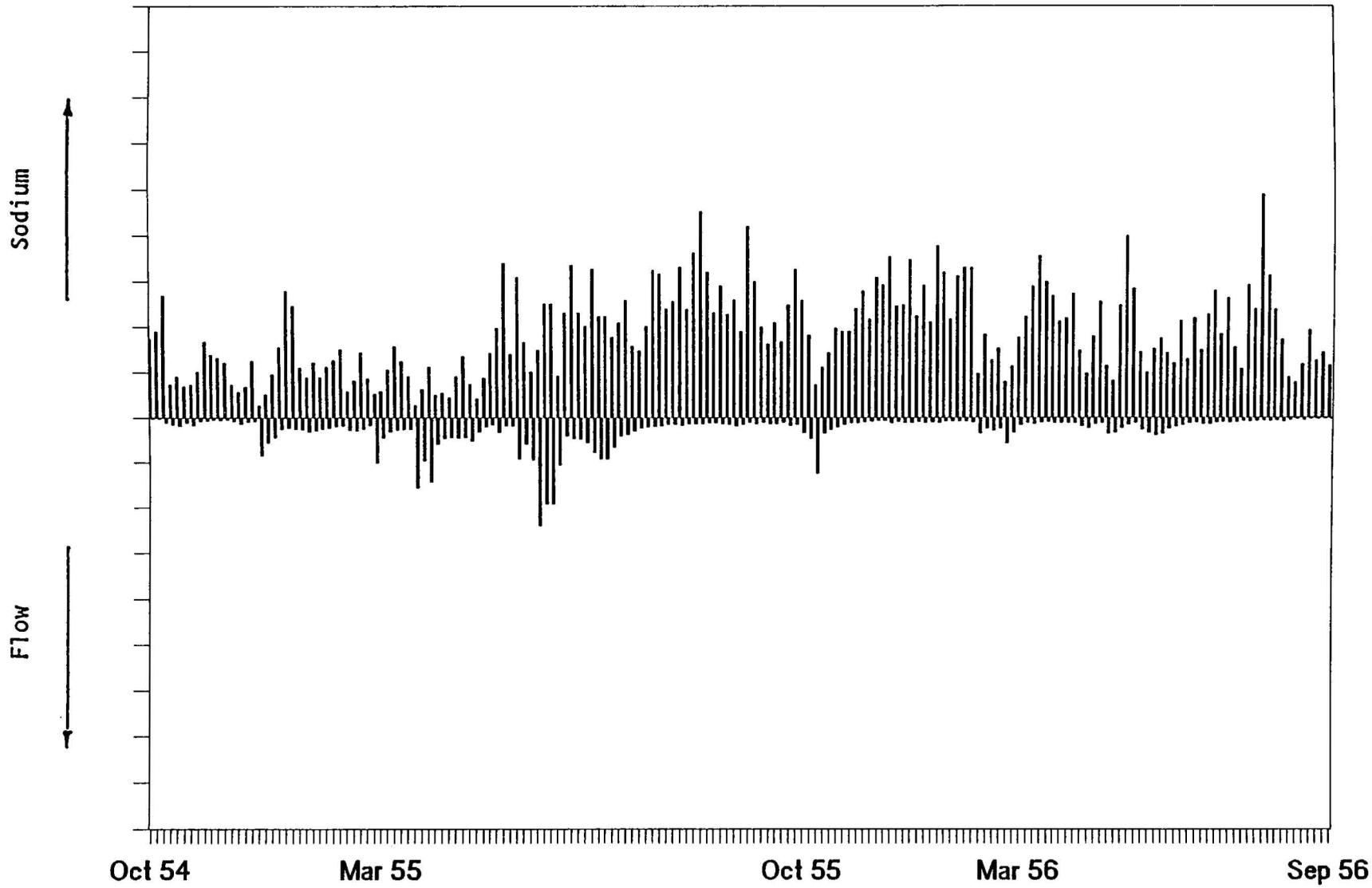

Figure 220. Graph of Sodium And Flow Versus Time For The Dardanelle Site 1954-1956.

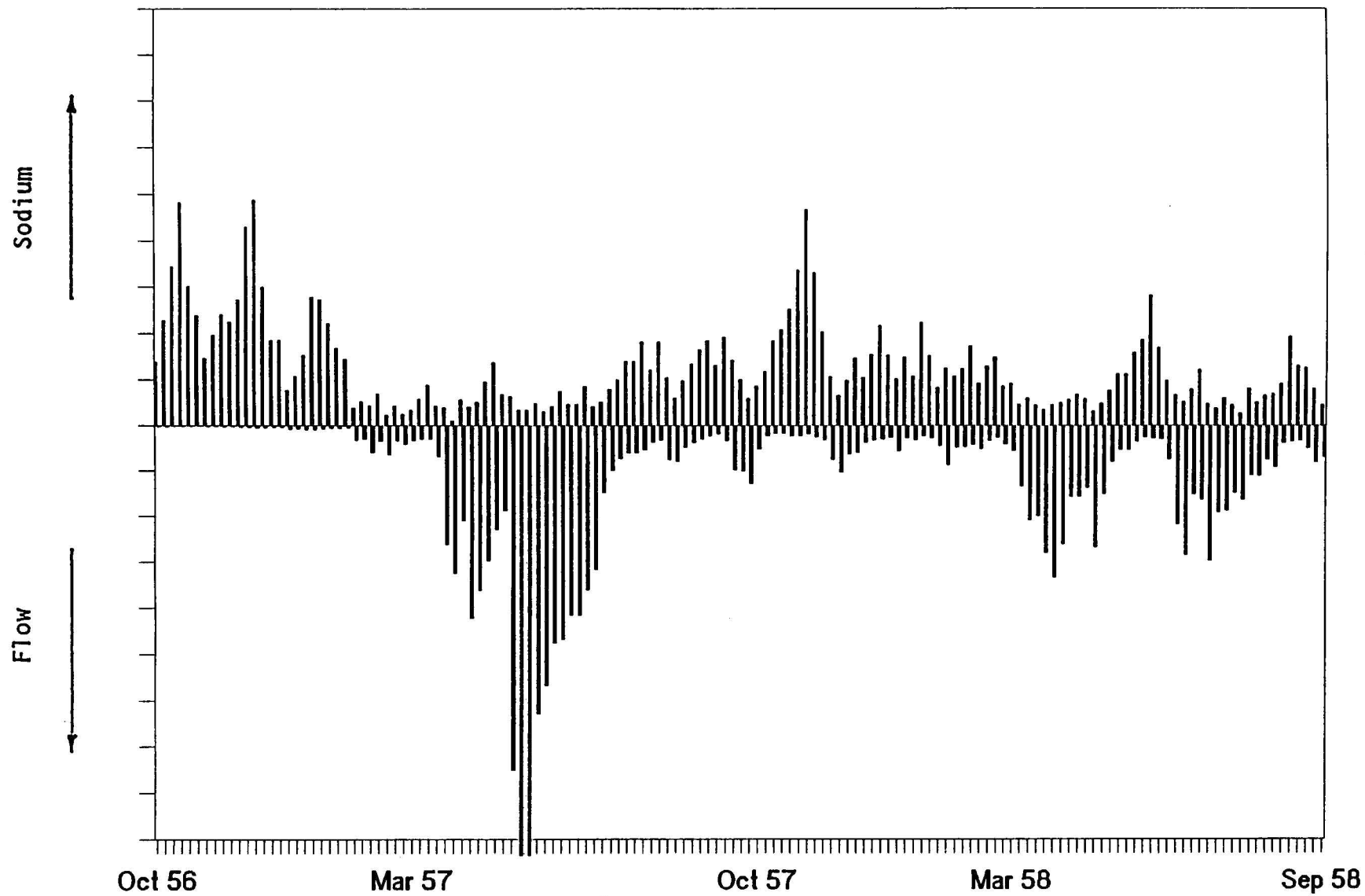

Figure 221. Graph of Sodium And Flow Versus Time For The Dardanelle Site 1956-1958.

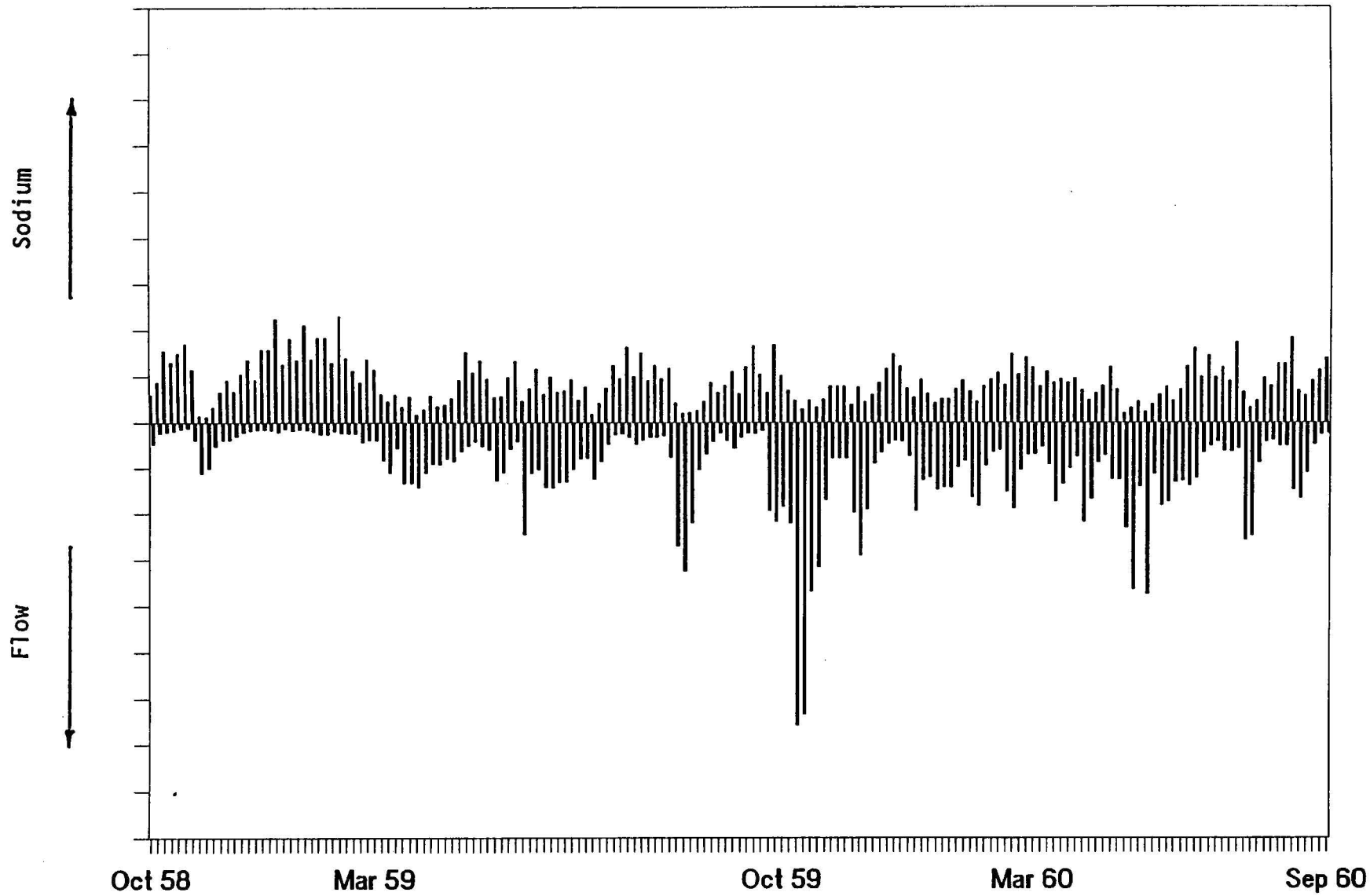

Figure 222. Graph of Sodium And Flow Versus Time For The Dardanelle Site 1958-1960.

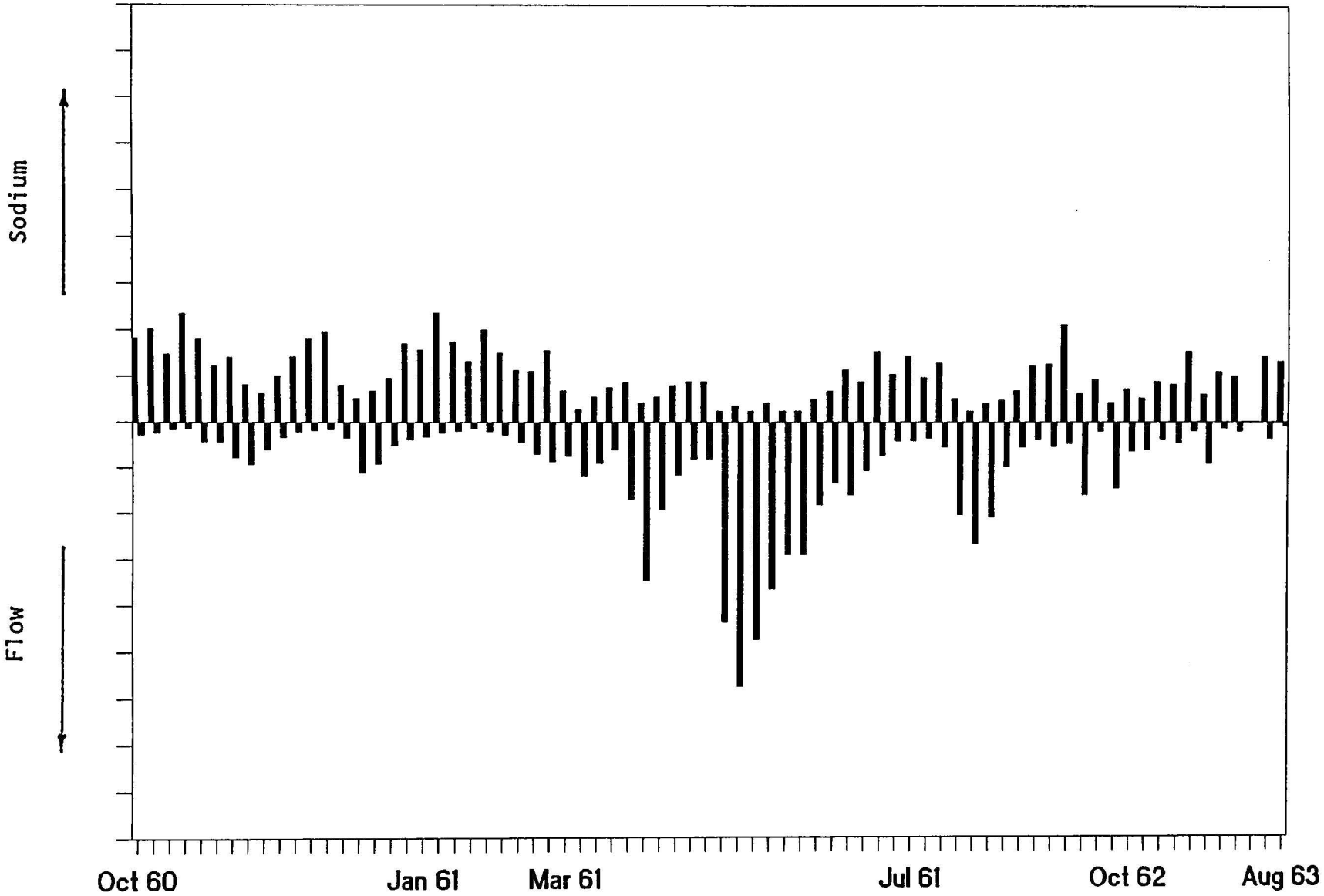

Figure 223. Graph of Sodium And Flow Versus Time For The Dardanelle Site 1960-1963.

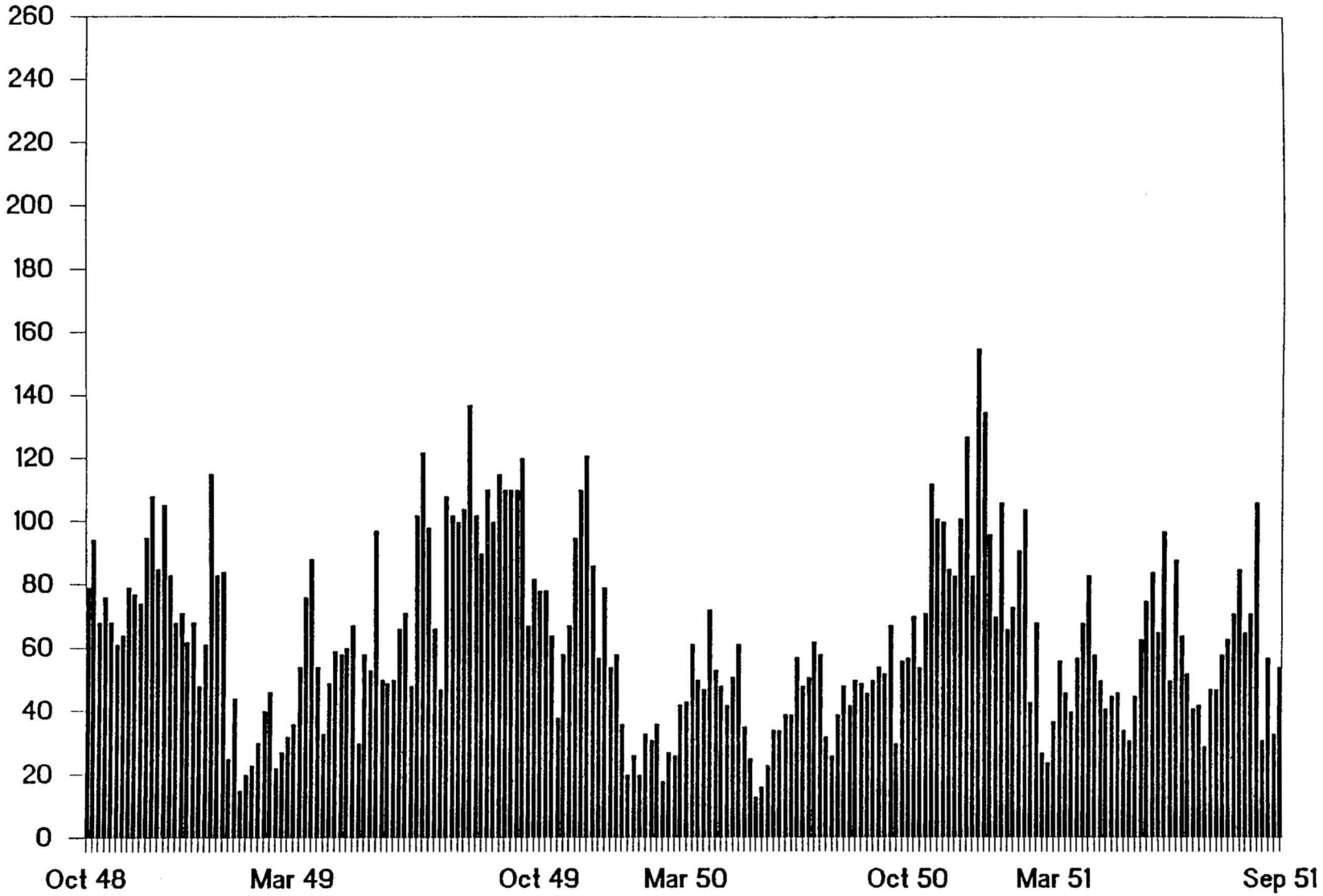

Figure 224. Graph of Sulfate Versus Time For The Dardanelle Site 1948-1951.

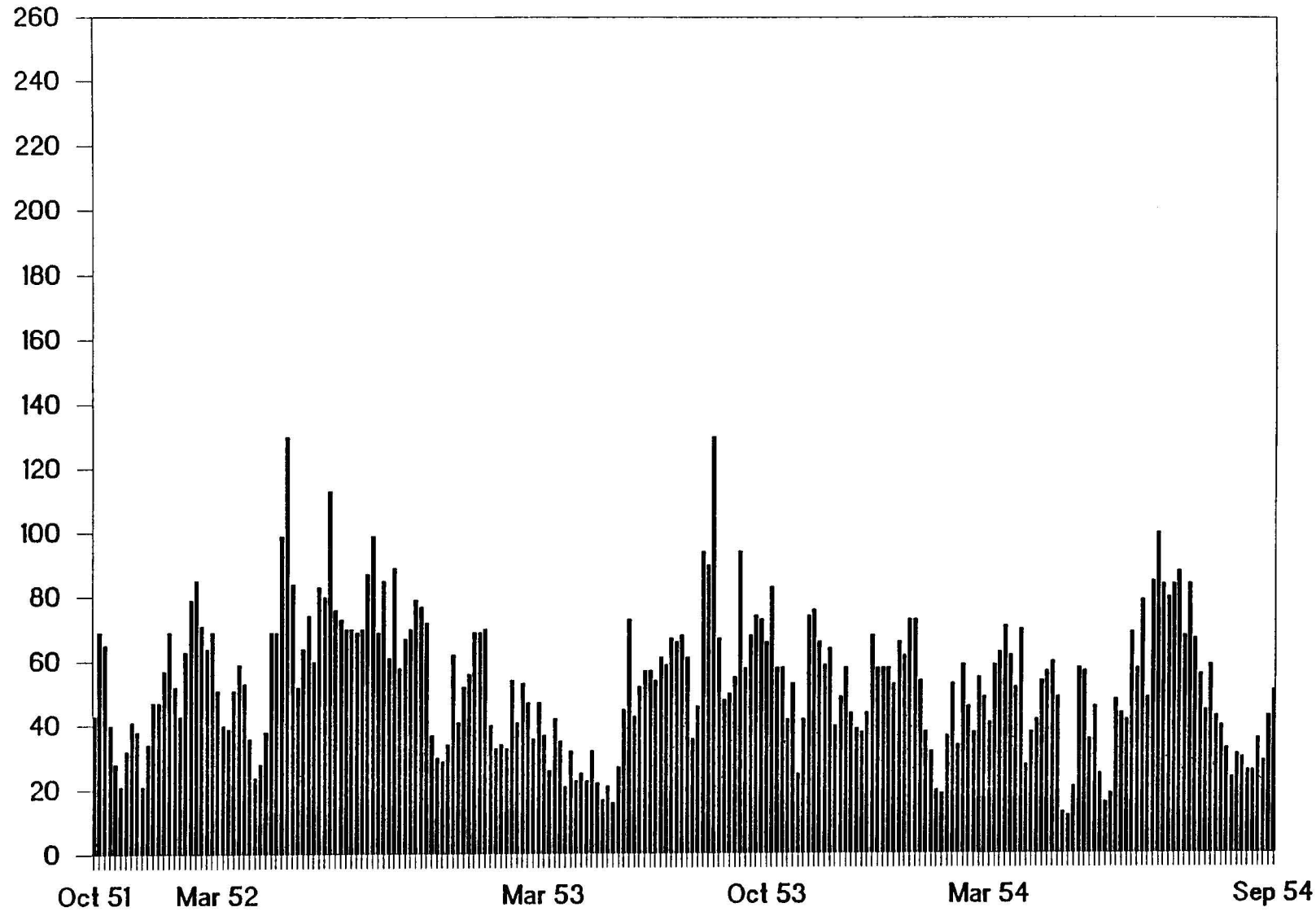

Figure 225. Graph of Sulfate Versus Time For The Dardanelle Site 1951-1954.

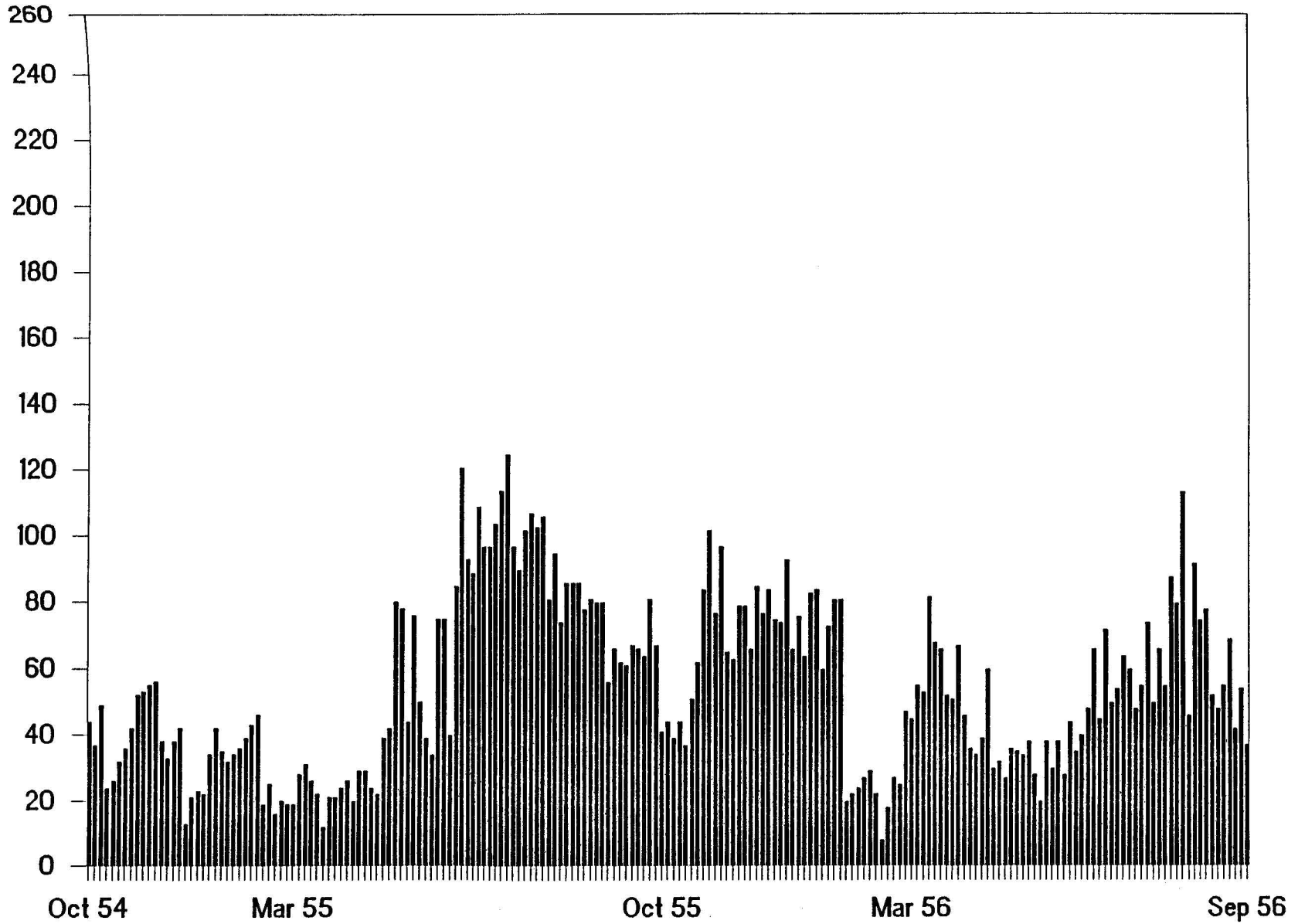

Figure 226. Graph of Sulfate Versus Time For The Dardanelle Site 1954-1956.

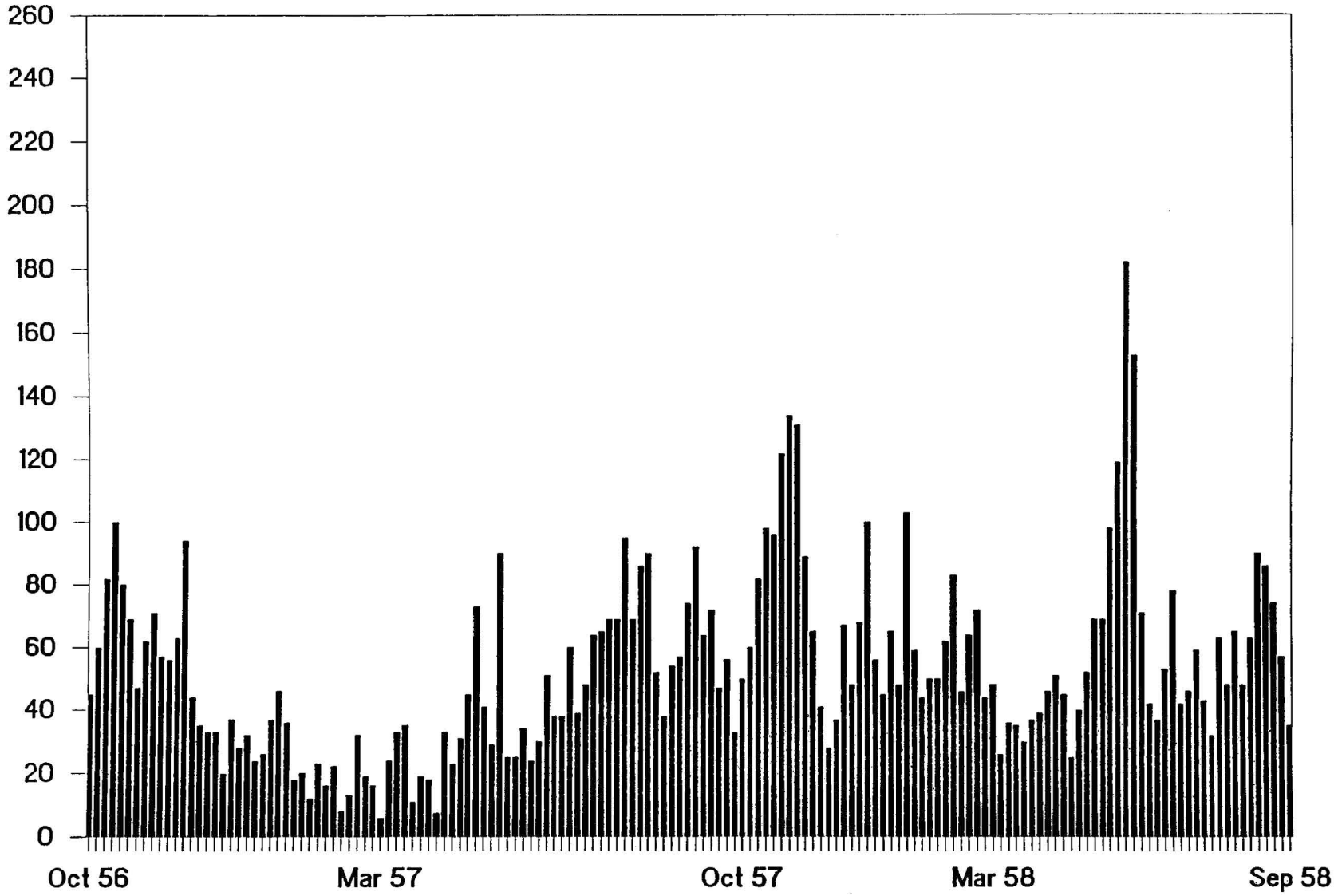

Figure 227. Graph of Sulfate Versus Time For The Dardanelle Site 1956-1958.

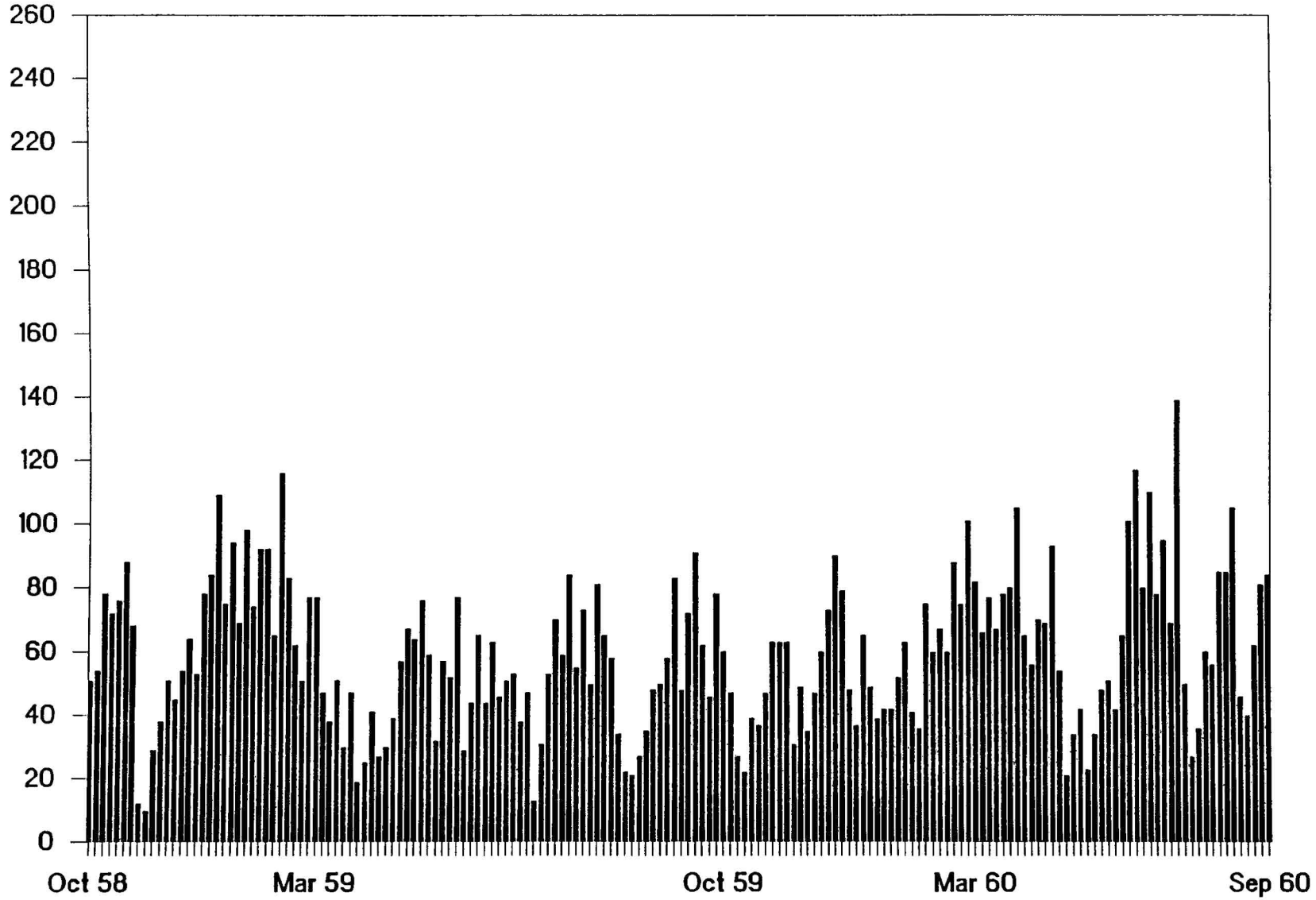

Figure 228. Graph of Sulfate Versus Time For The Dardanelle Site 1958-1960.

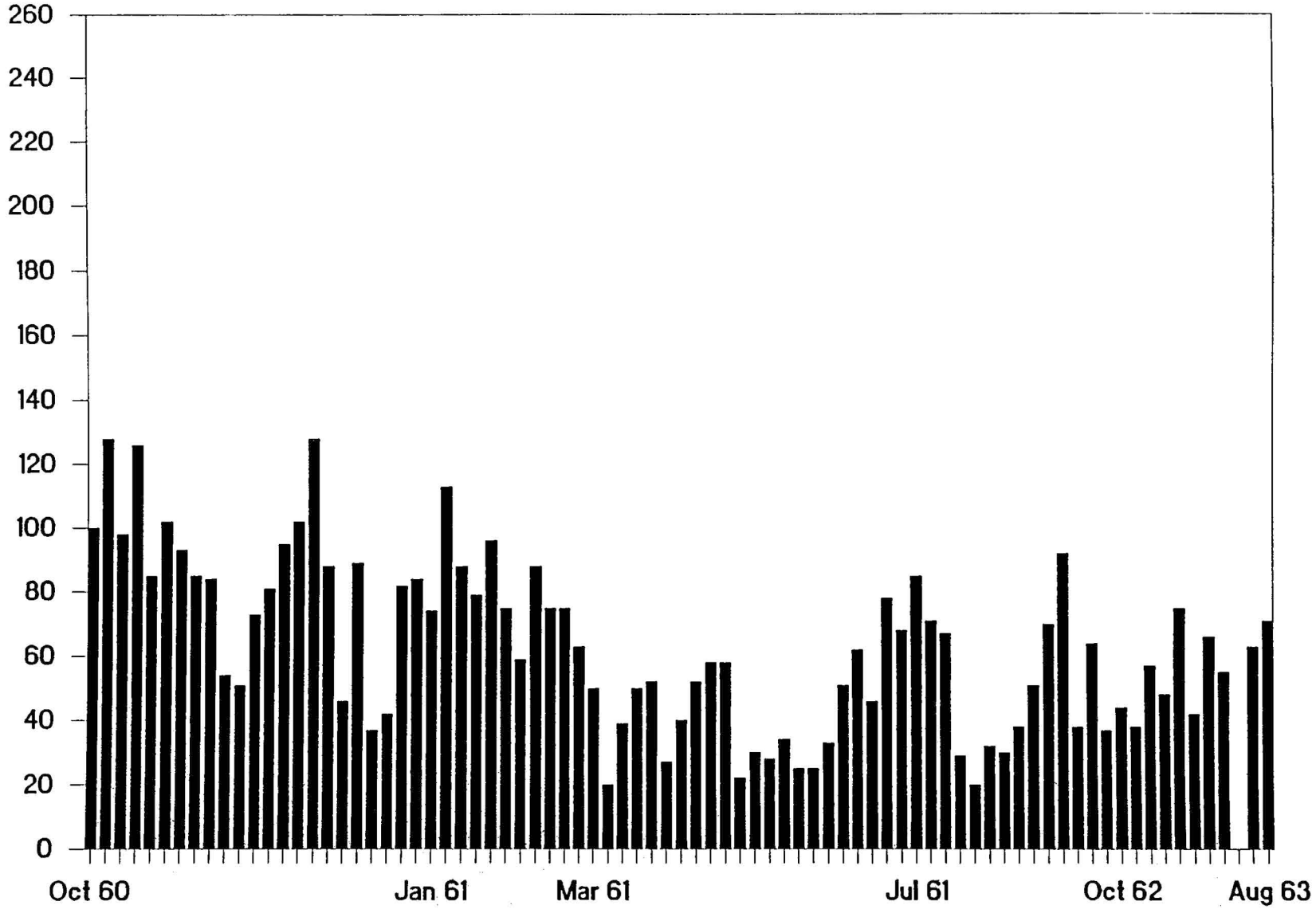

Figure 229. Graph of Sulfate Versus Time For The Dardanelle Site 1960-1963.

until 1963. All data for this period are plotted in Figure 230. The more recent data from 1974 until 1986 are plotted in Figure 231. Figures 232 through 238 show both flow and sulfate plotted as a function of time.

Suspended Solids. The suspended solids concentrations ranged from 0 to 112 mg/L with an average concentration of 26 mg/L. The record included 128 observations.

Total Hardness. The average total hardness concentration was 190 mg/L. The data are shown graphically in Figures 239 through 244 show the data for relatively short-term periods of time. The average total hardness concentration for the period of record prior to 1963 was 195 mg/L. The minimum and maximum concentrations were 32 and 583 mg/L, respectively. The record included 1,020 observations for this period. The average concentration for the period of record after 1974 was 121 mg/L. Figure 245 shows the data for the period from 1974 until 1986. Figure 246 shows the data from 1948 until 1963 plotted on a single graph. The minimum and maximum total hardness concentrations for the 70 concentrations reported for this period were 14 and 180 mg/L, respectively. Figure 247 through 253 show both total hardness and flow as a function of time.

Turbidity. The minimum and maximum turbidity values were 4 and 110 turbidity units, respectively. The average value was 31 turbidity units. Sixty-six values were included in the record. The data are shown in Figure 254. The period of record included the years from 1980 until 1986. Both flow and turbidity are shown graphically as a function of

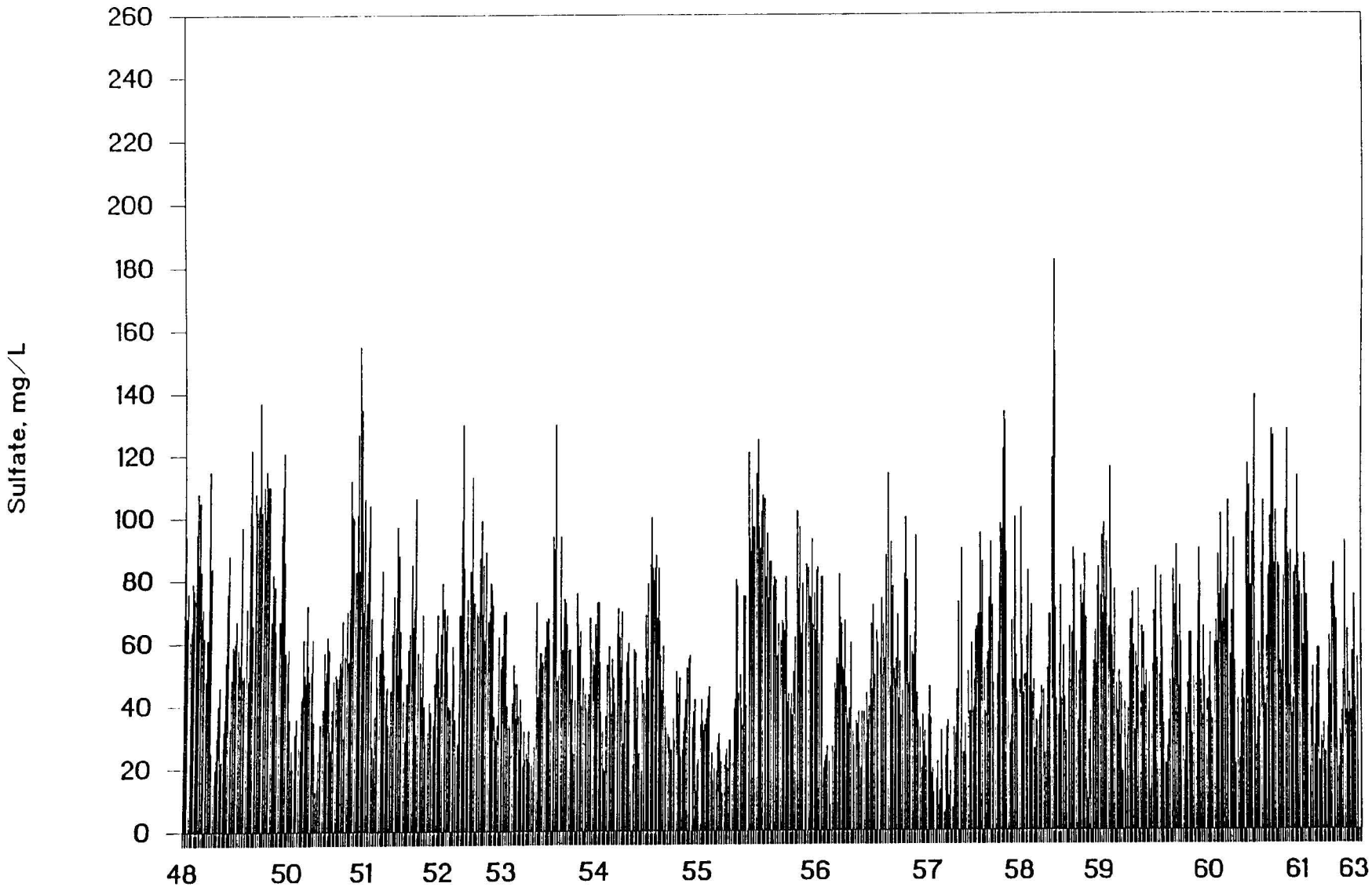

Figure 230. Graph of Sulfate Versus Time For The Dardanelle Site 1948-1963.

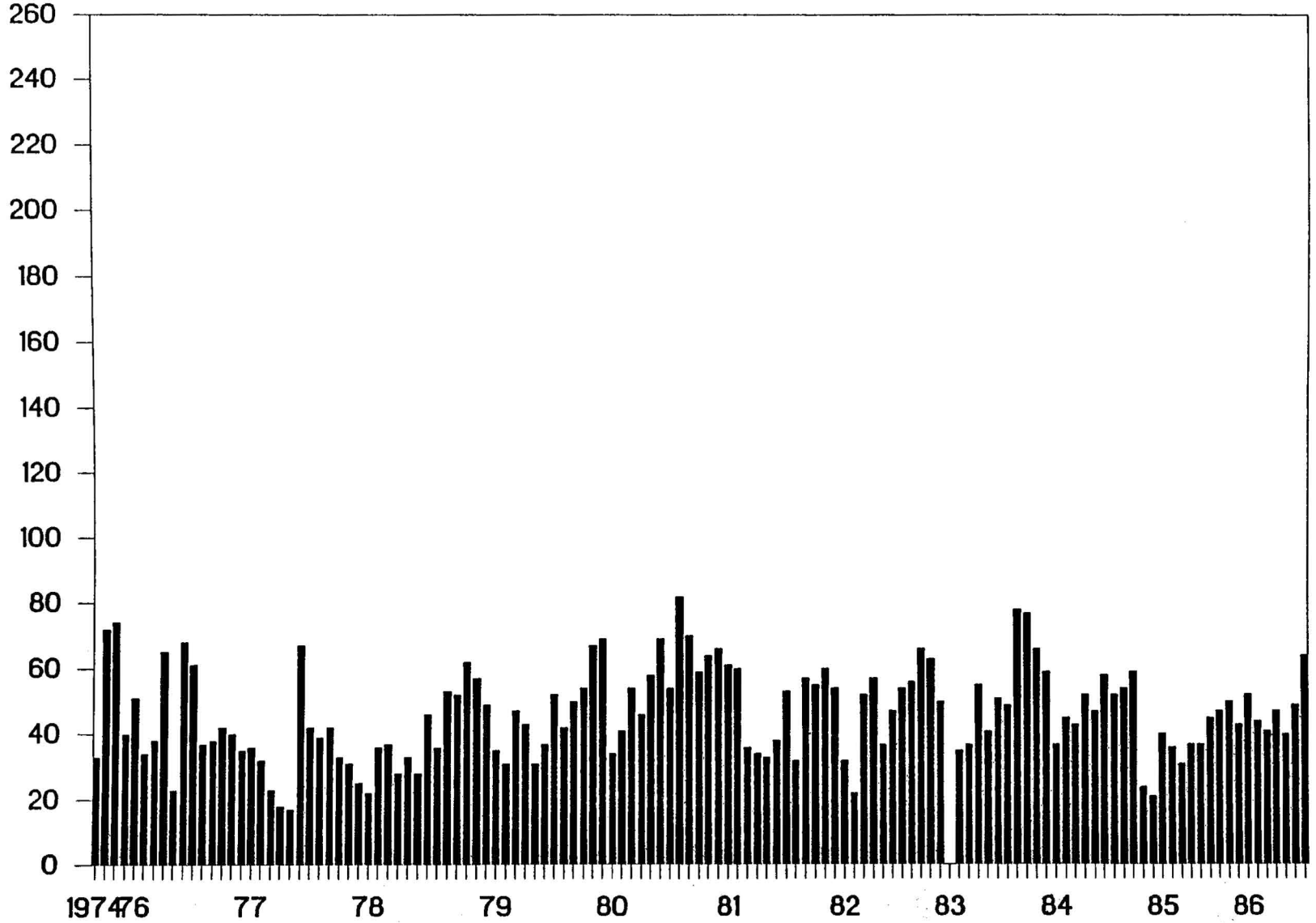

Figure 231. Graph of Sulfate Versus Time For The Dardanelle Site 1974-1986.

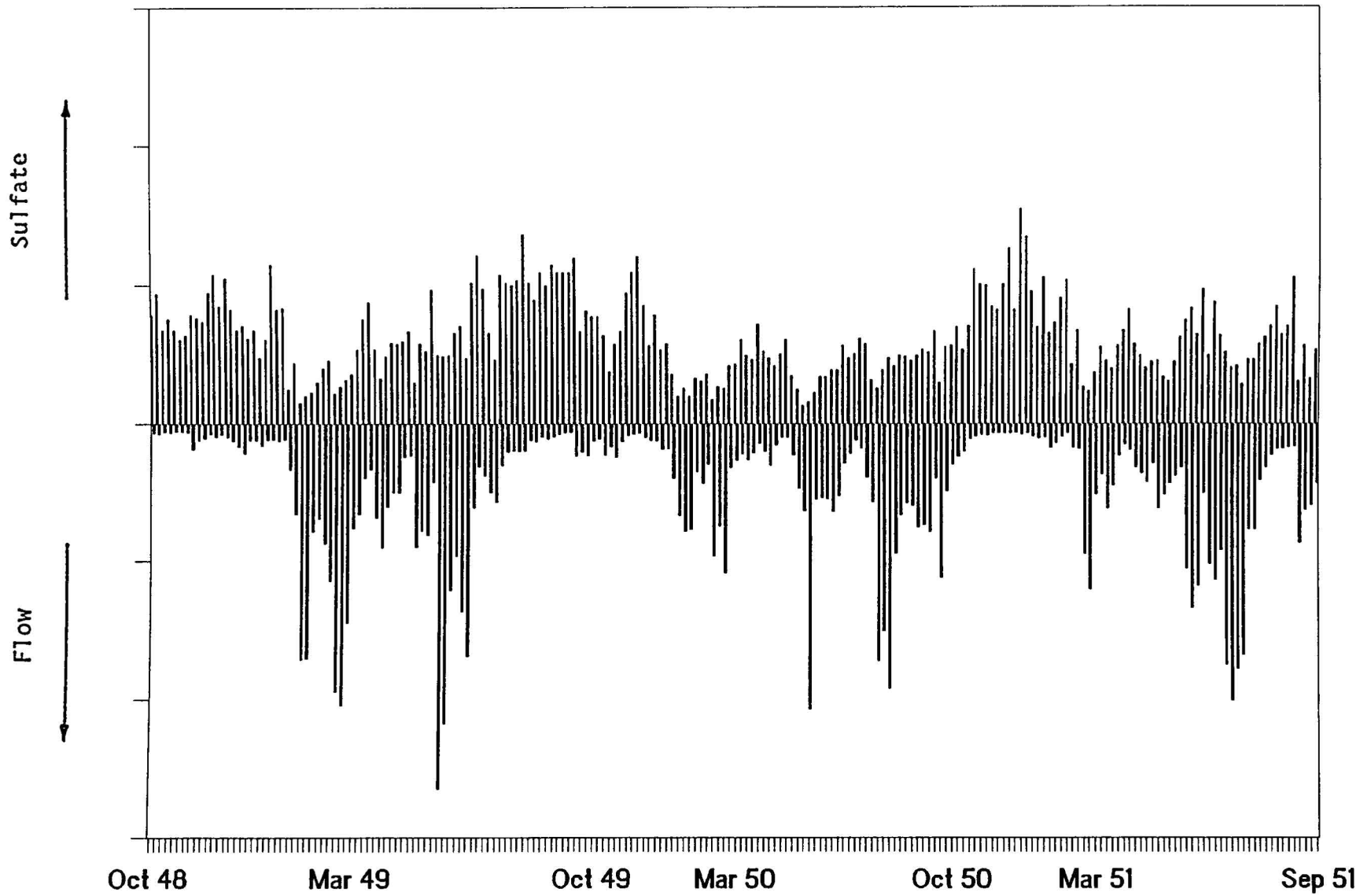

Figure 232. Graph of Sulfate And Flow Versus Time For The Dardanelle Site 1948-1951.

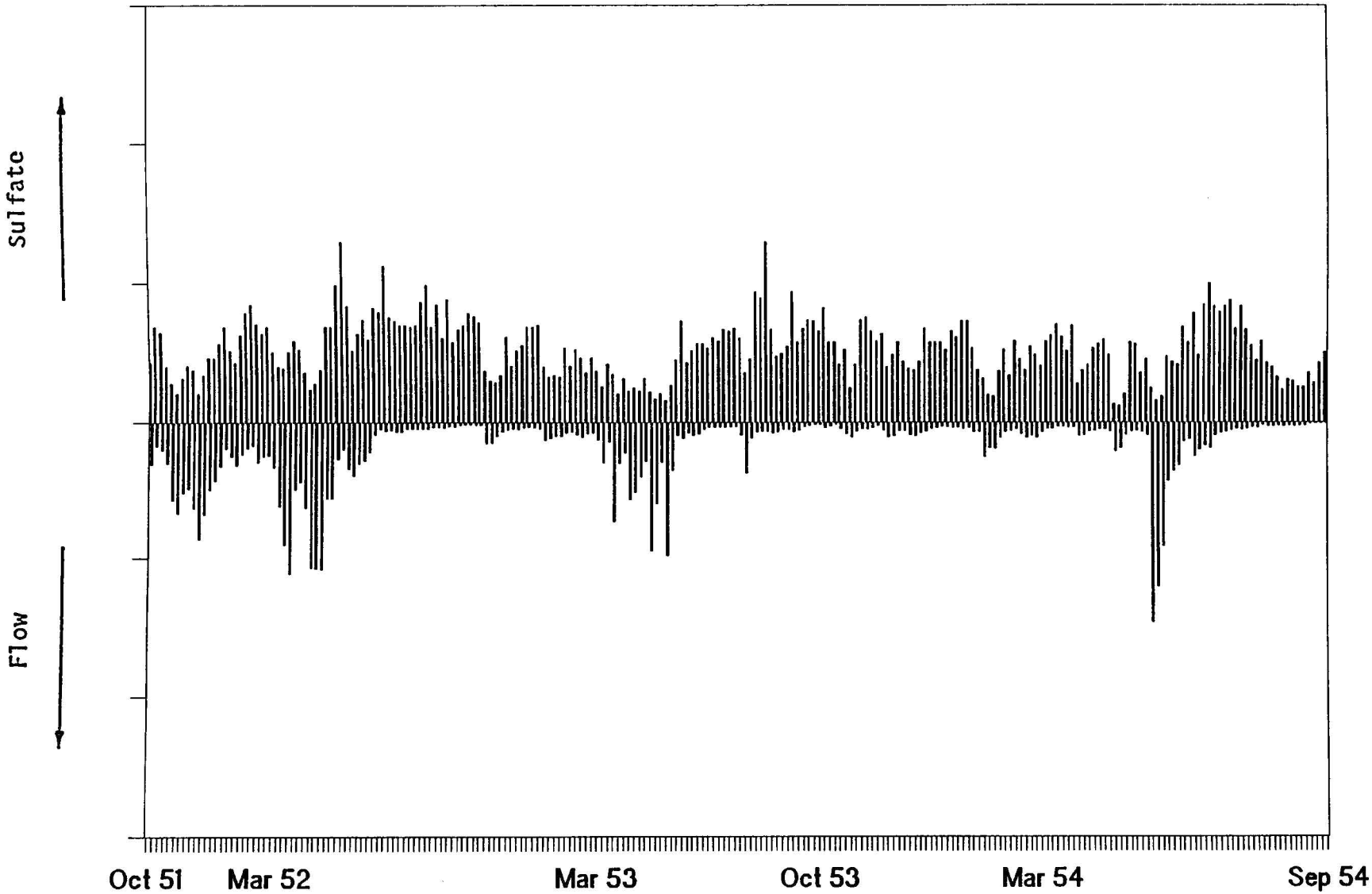

Figure 233. Graph of Sulfate And Flow Versus Time For The Dardanelle Site 1951-1954.

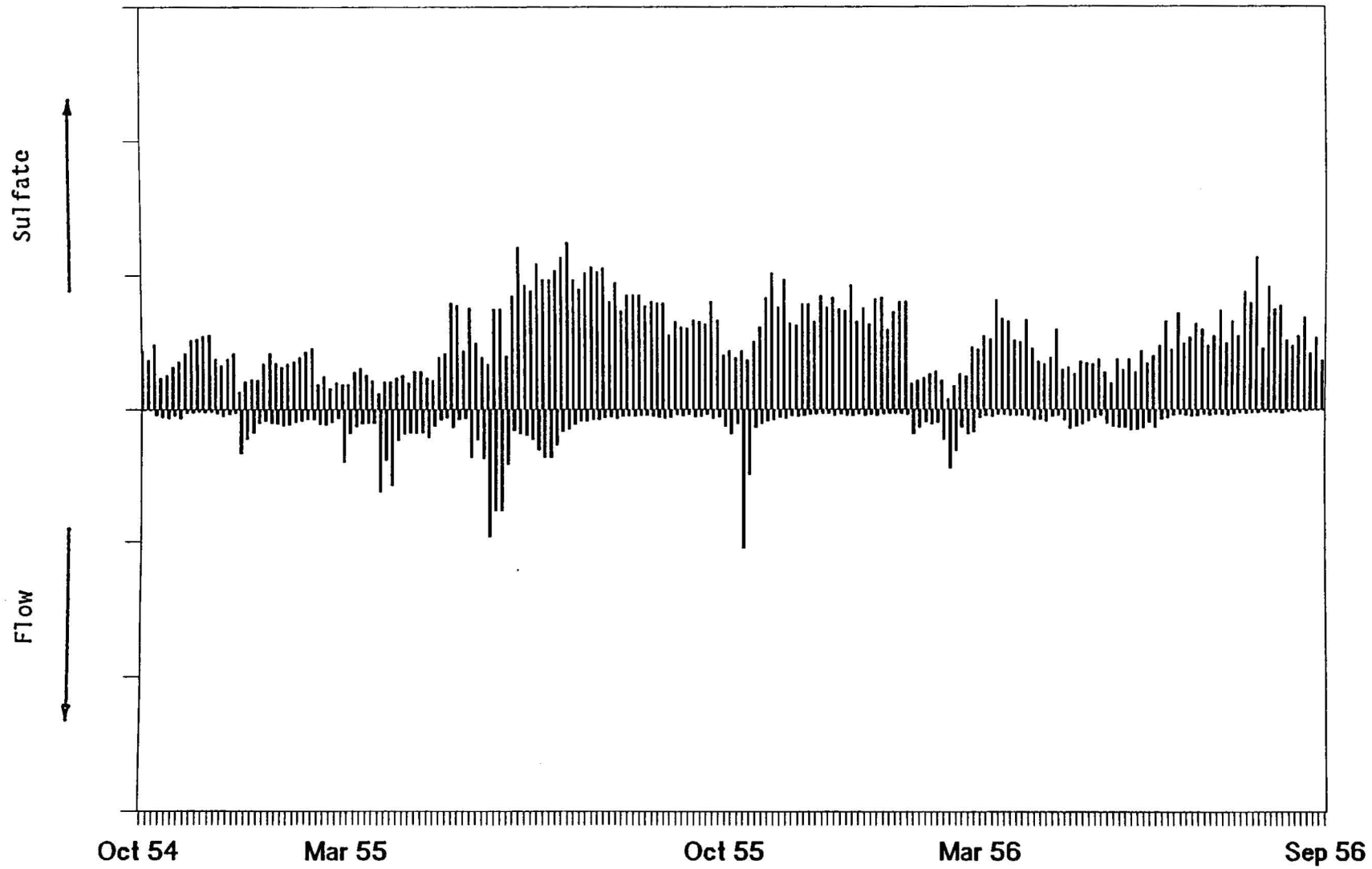

Figure 234. Graph of Sulfate And Flow Versus Time For The Dardanelle Site 1954-1956.

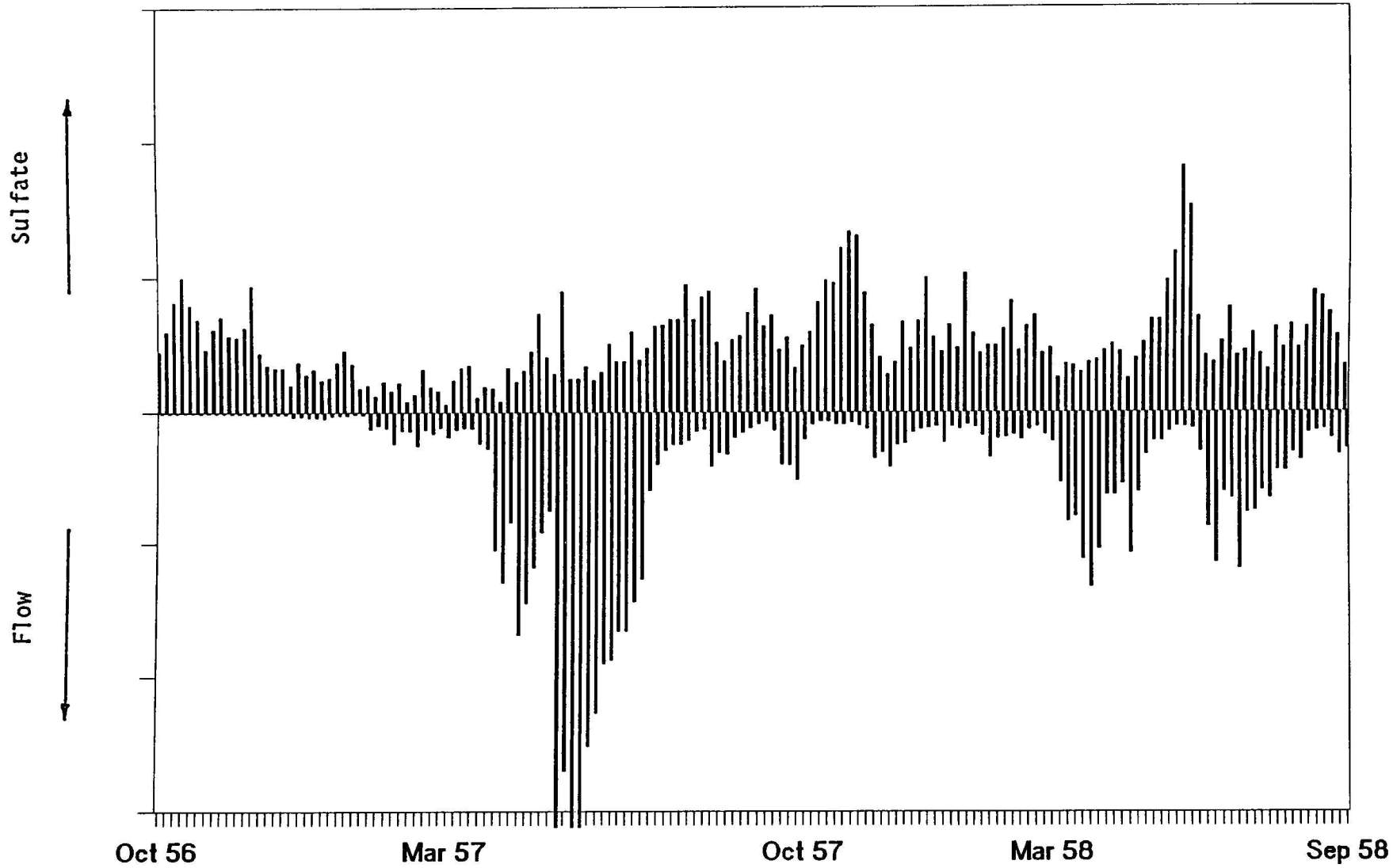

Figure 235. Graph of Sulfate And Flow Versus Time For The Dardanelle Site 1956-1958.

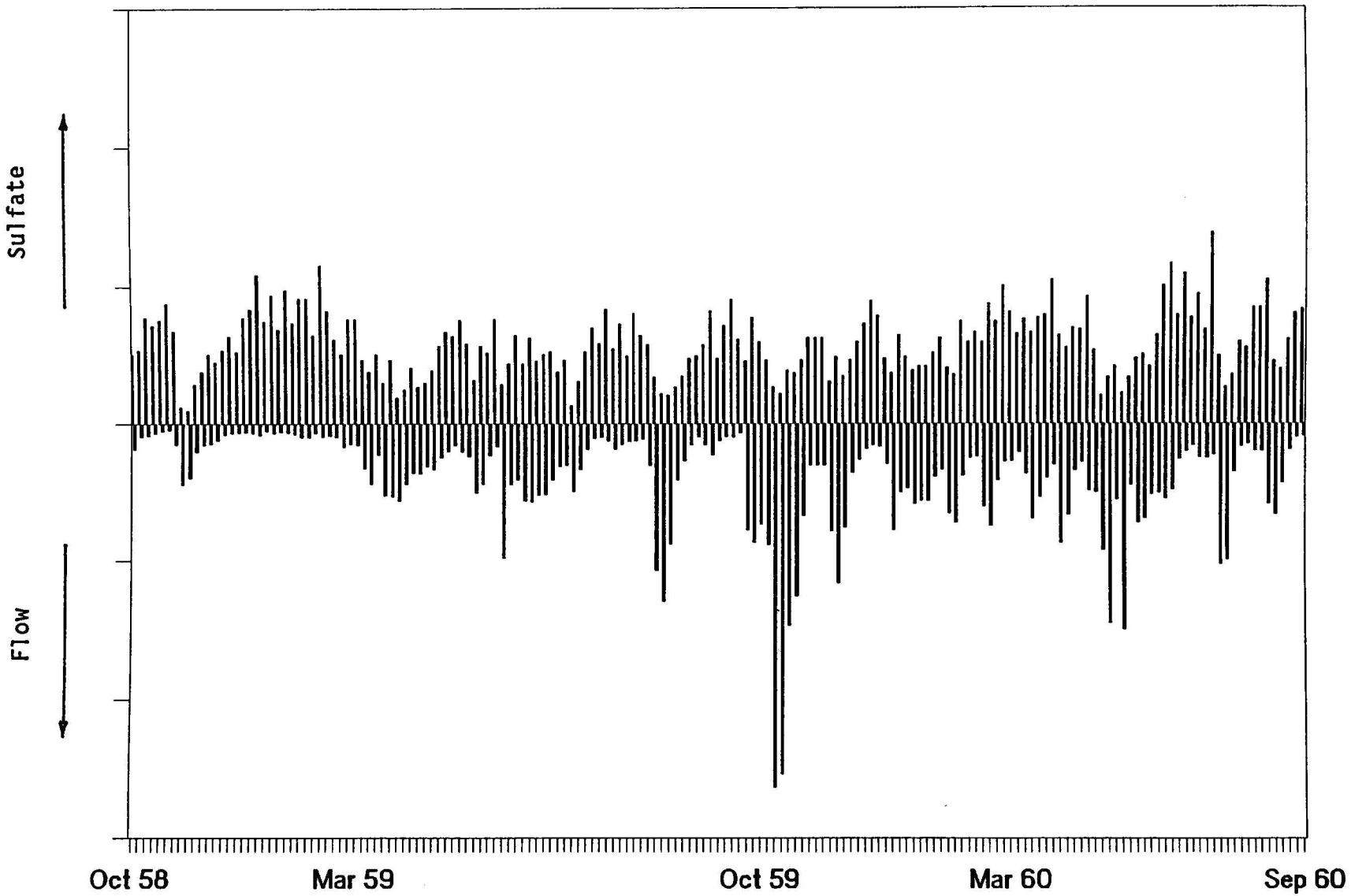

Figure 236. Graph of Sulfate And Flow Versus Time For The Dardanelle Site 1958-1960.

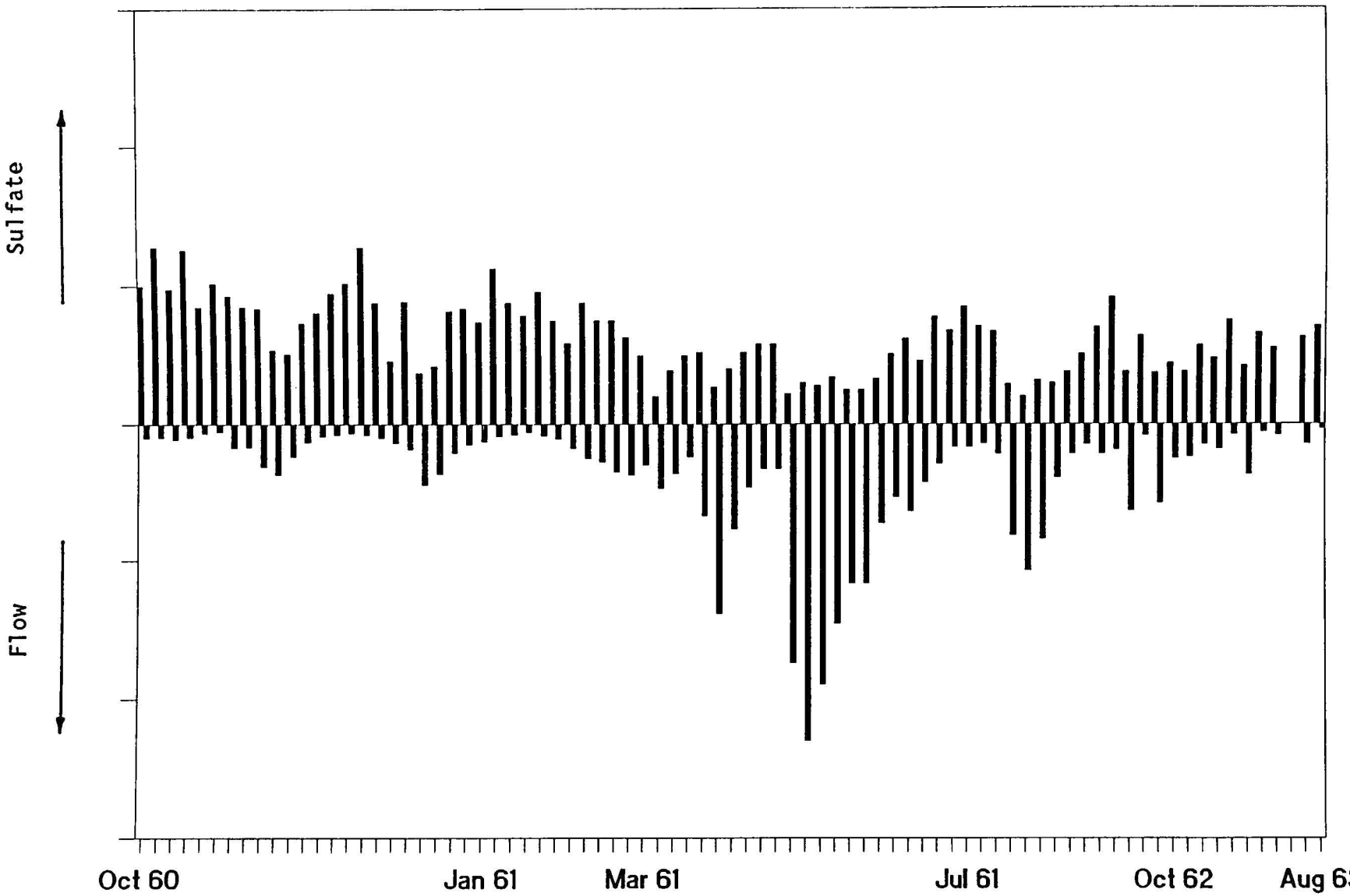

Figure 237. Graph of Sulfate And Flow Versus Time For The Dardanelle Site 1960-1963.

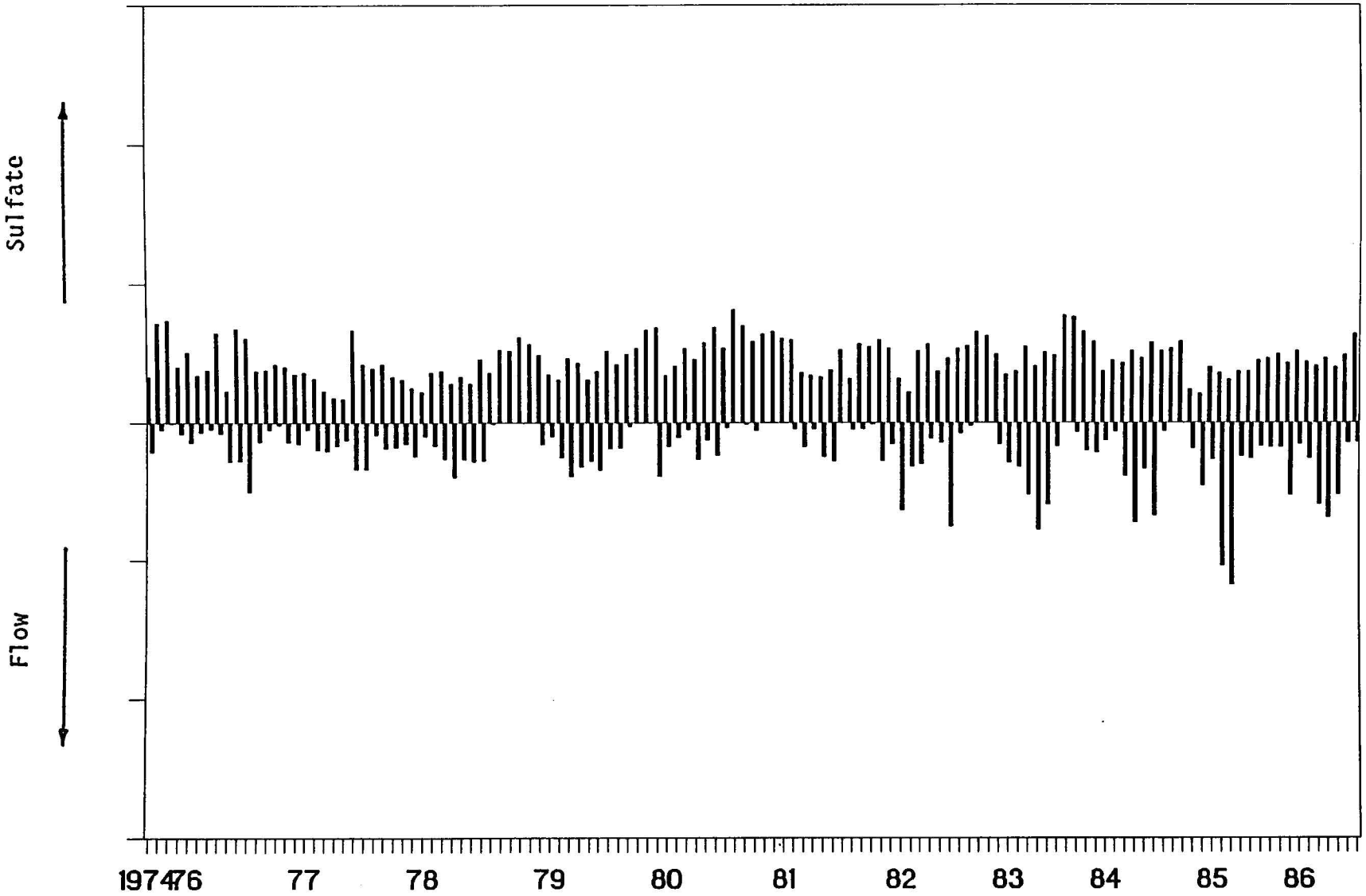

Figure 238. Graph of Sulfate And Flow Versus Time For The Dardanelle Site 1974-1986.

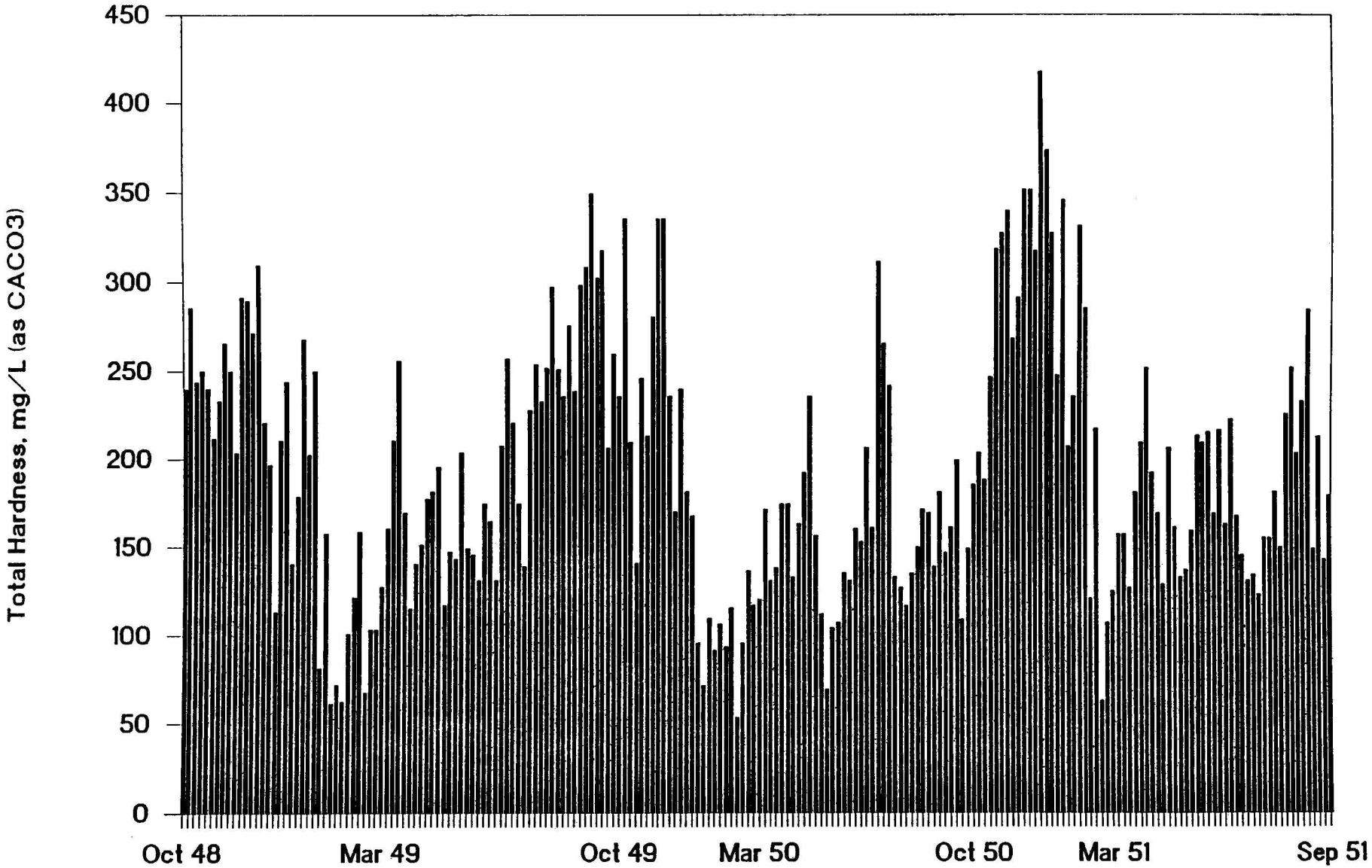

Figure 239. Graph of Total Hardness Versus Time For The Dardanelle Site 1948-1951.

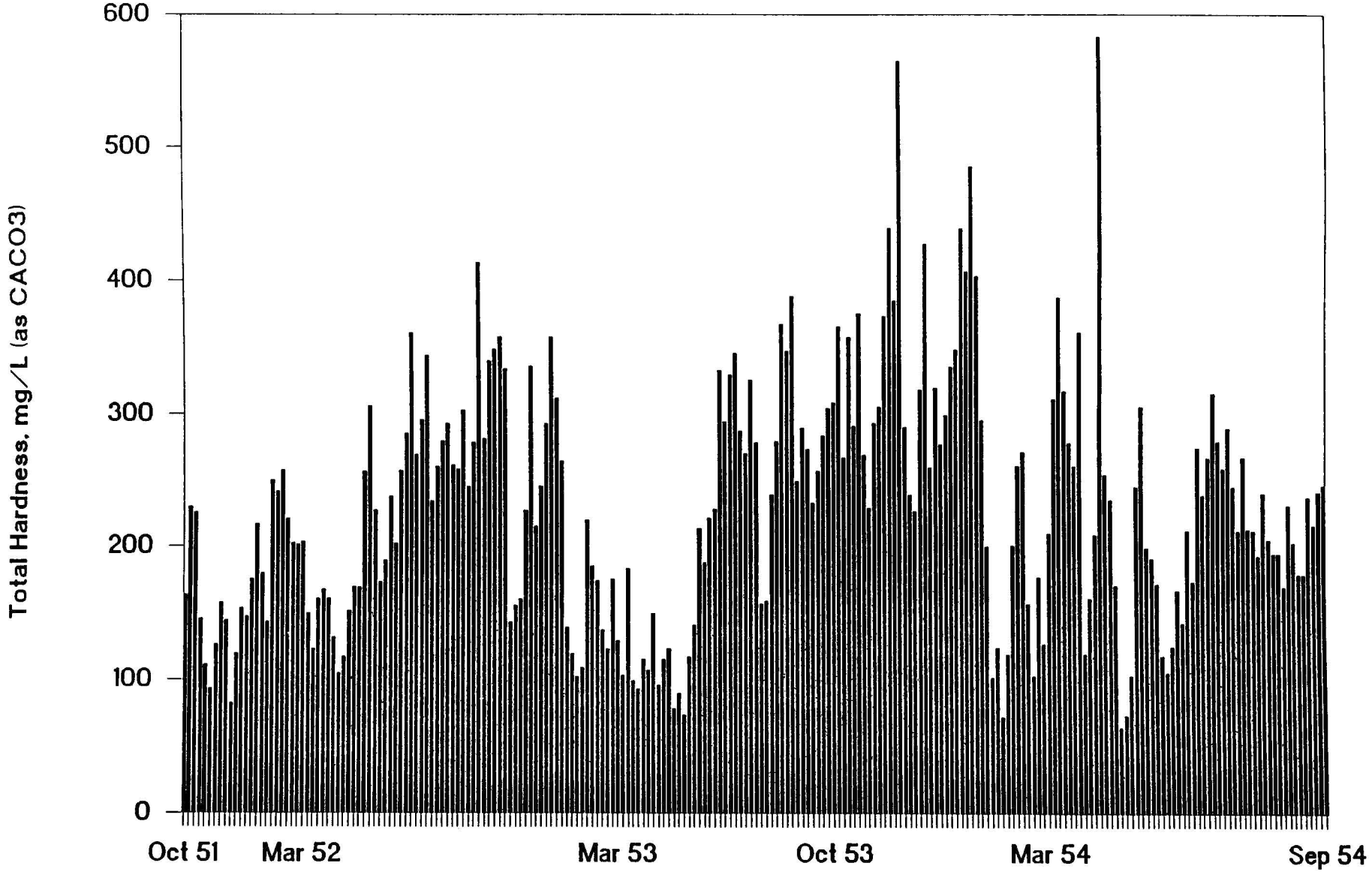

Figure 240. Graph of Total Hardness Versus Time For The Dardanelle Site 1951-1954.

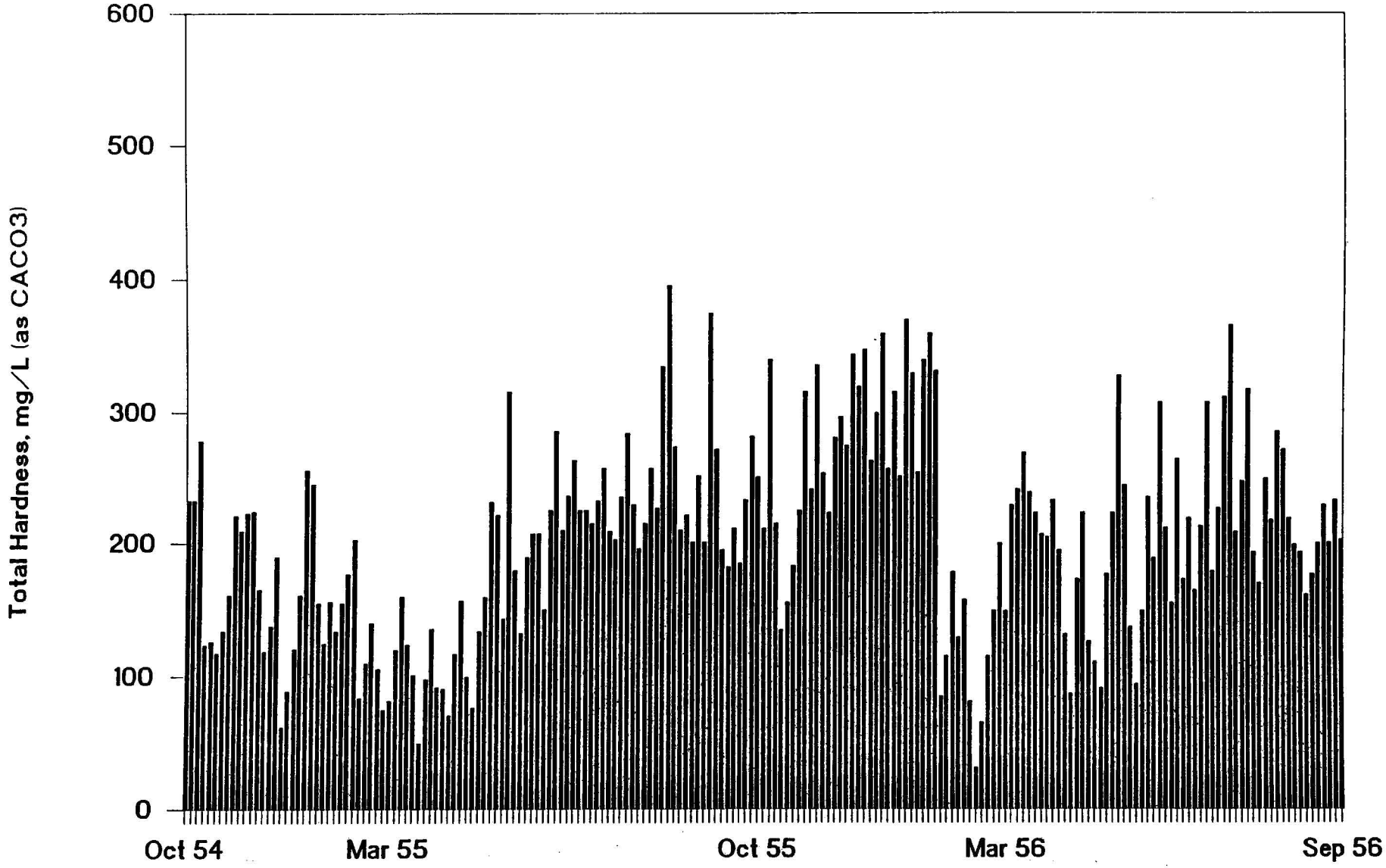

Figure 241. Graph of Total Hardness Versus Time For The Dardanelle Site 1954-1956.

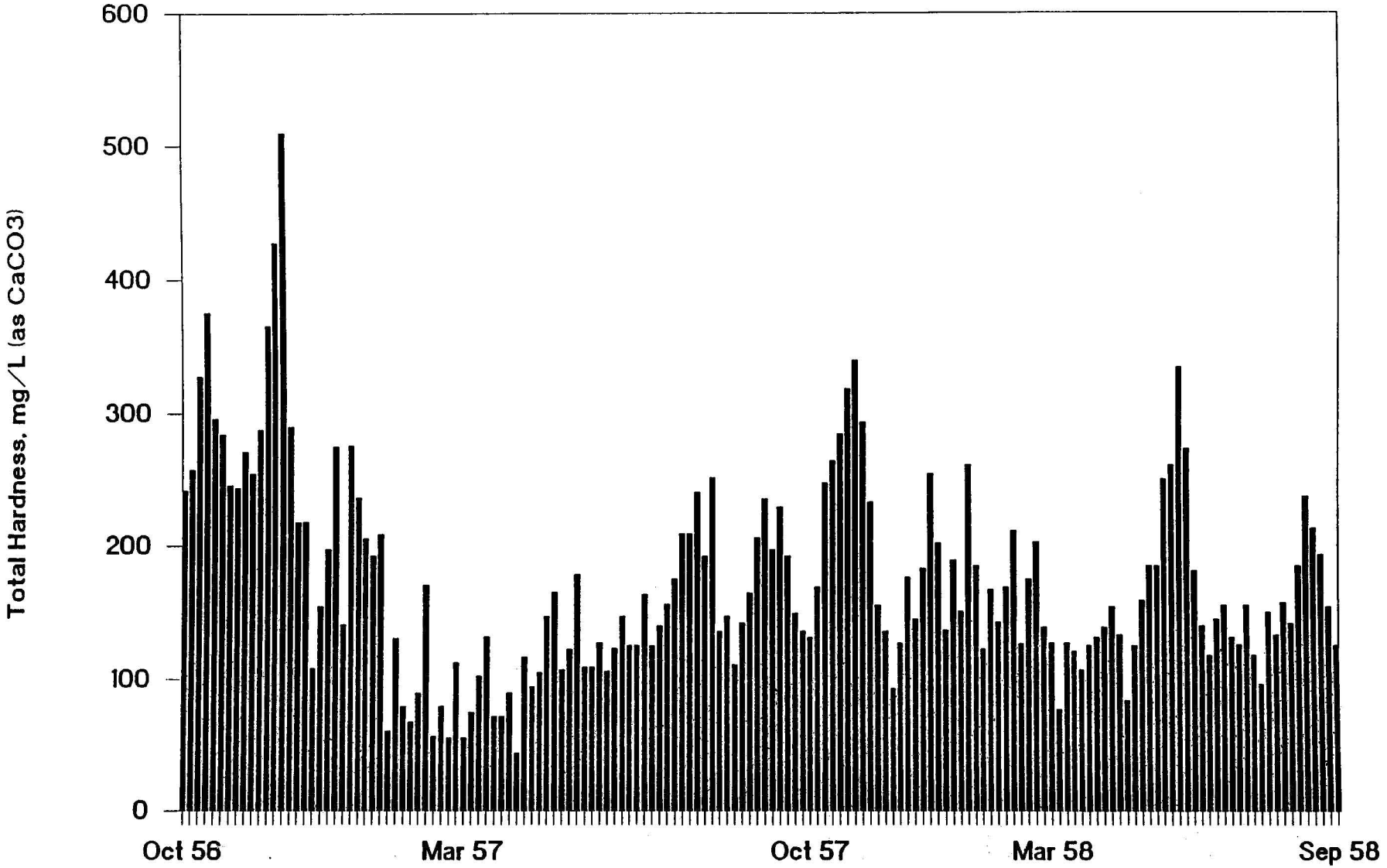

Figure 242. Graph of Total Hardness Versus Time For The Dardanelle Site 1956-1958.

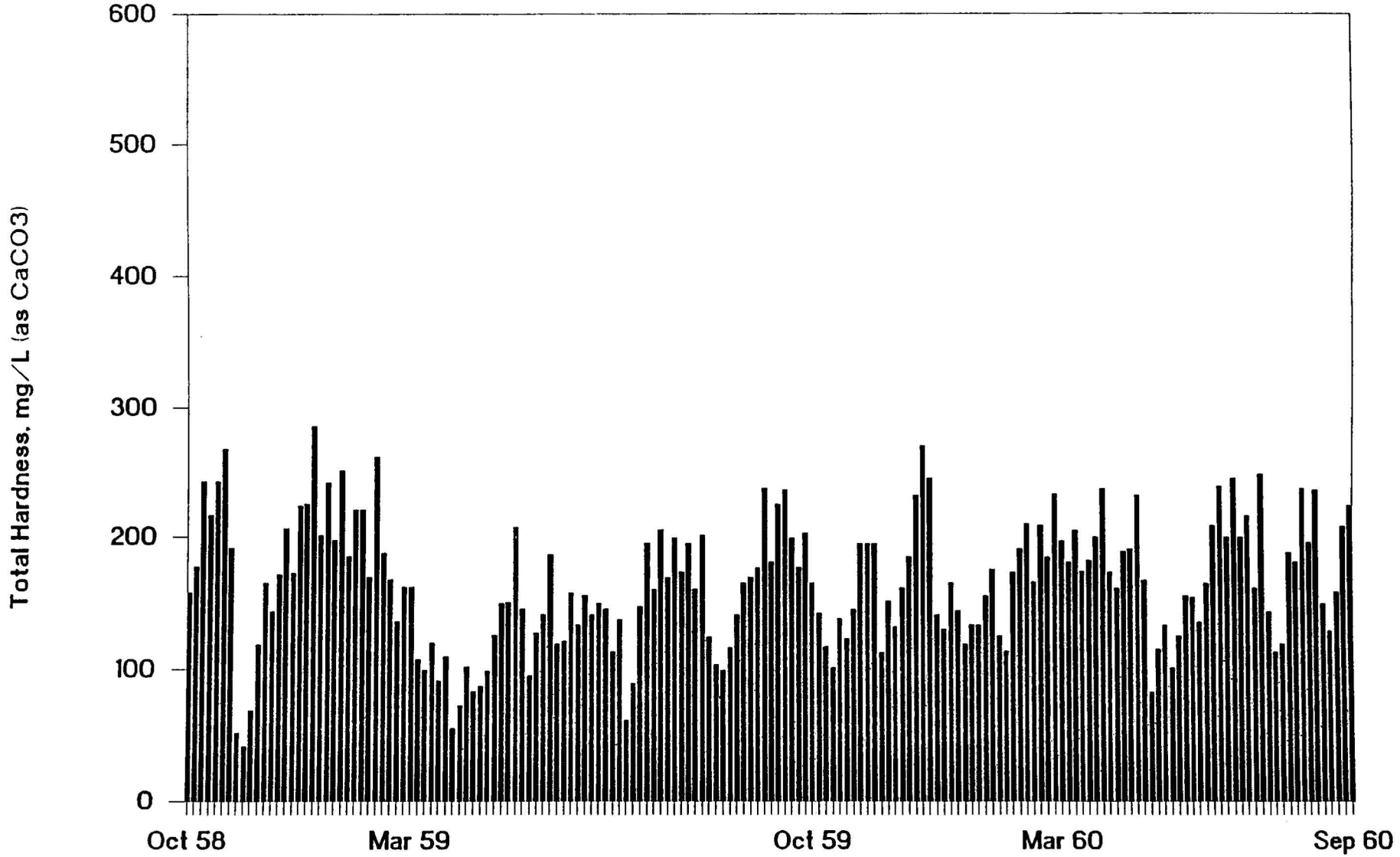

Figure 243. Graph of Total Hardness Versus Time For The Dardanelle Site 1958-1960.

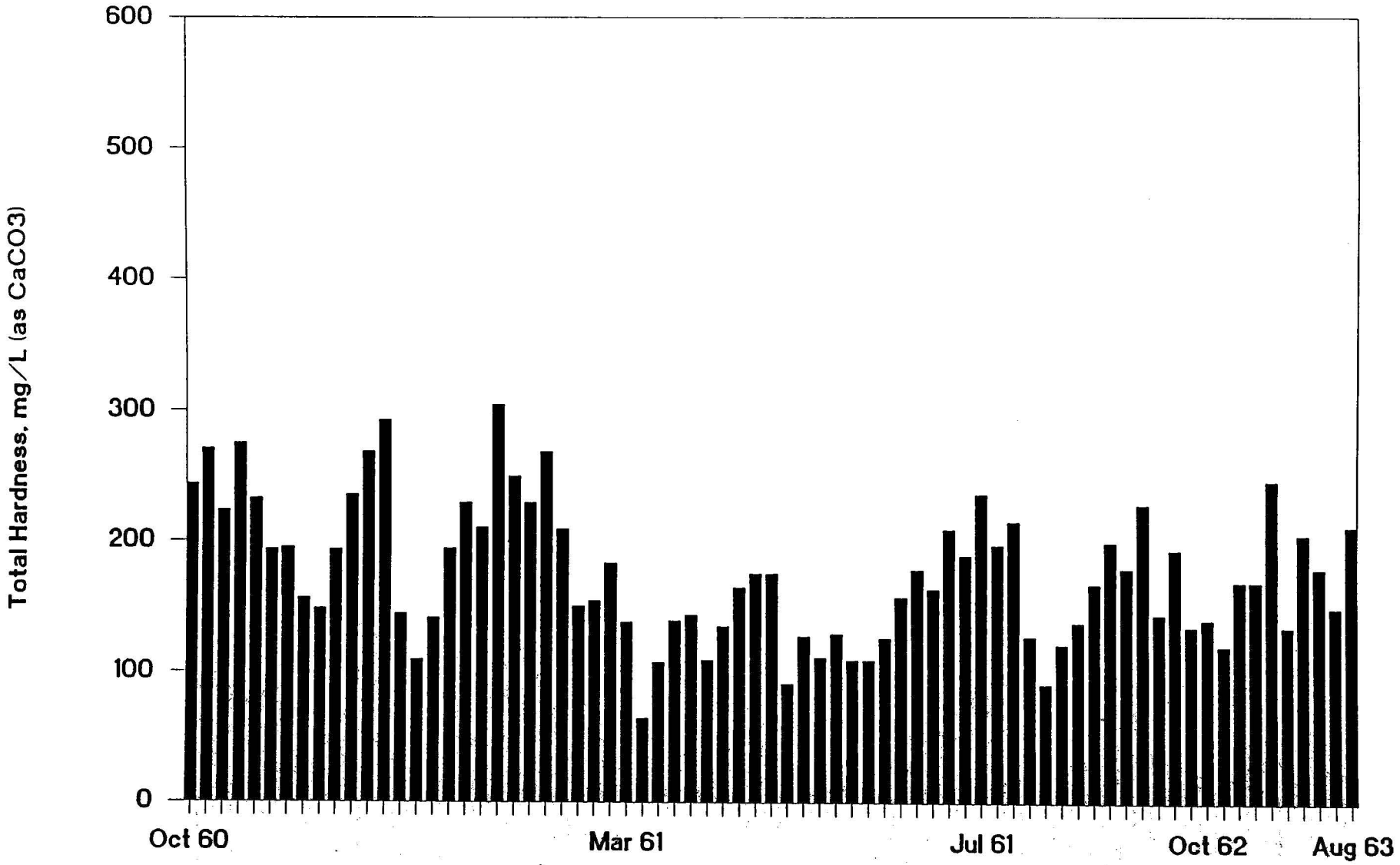

Figure 244. Graph of Total Hardness Versus Time For The Dardanelle Site 1960-1963.

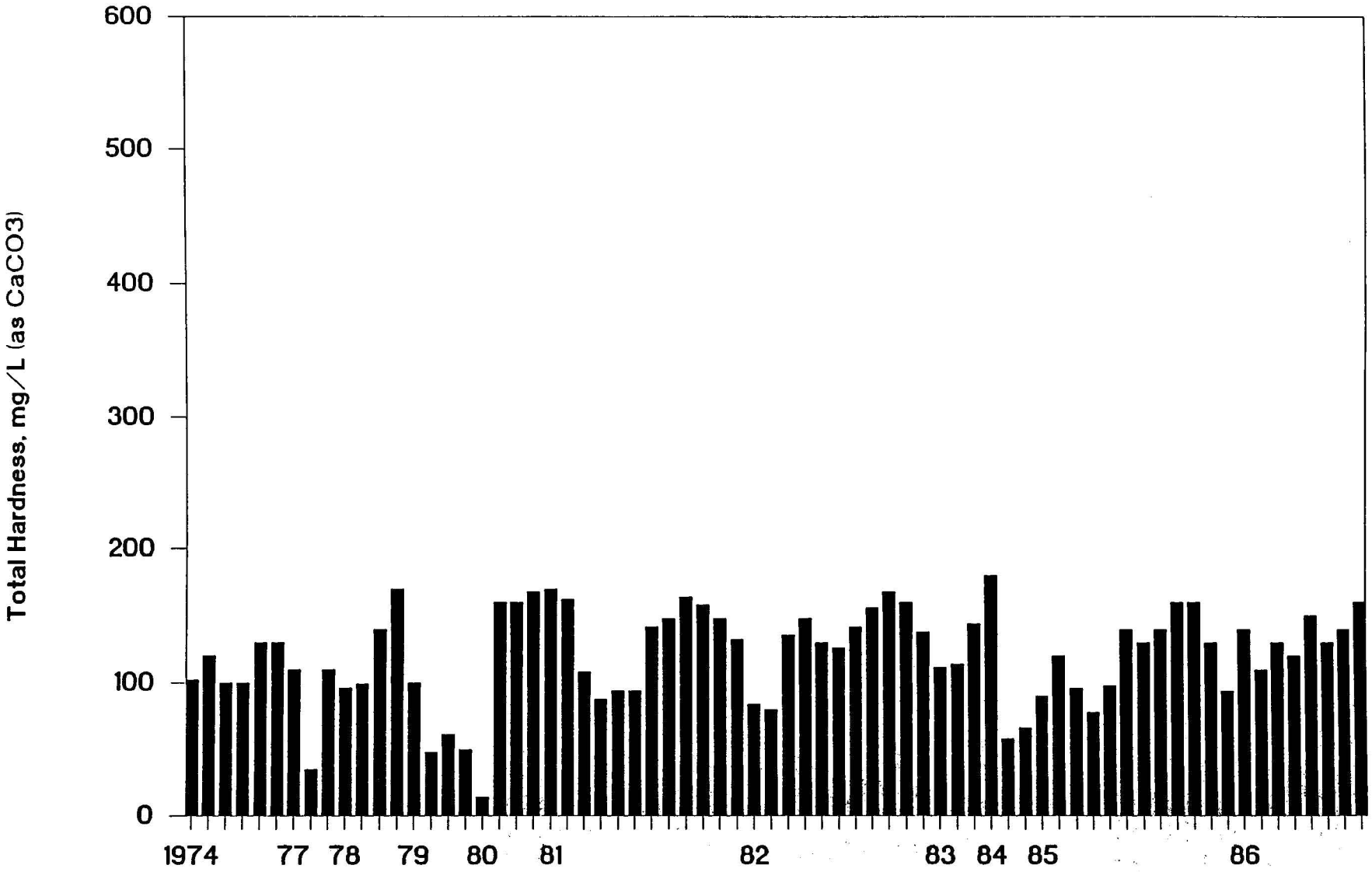

Figure 245. Graph of Total Hardness Versus Time For The Dardanelle Site 1974-1986.

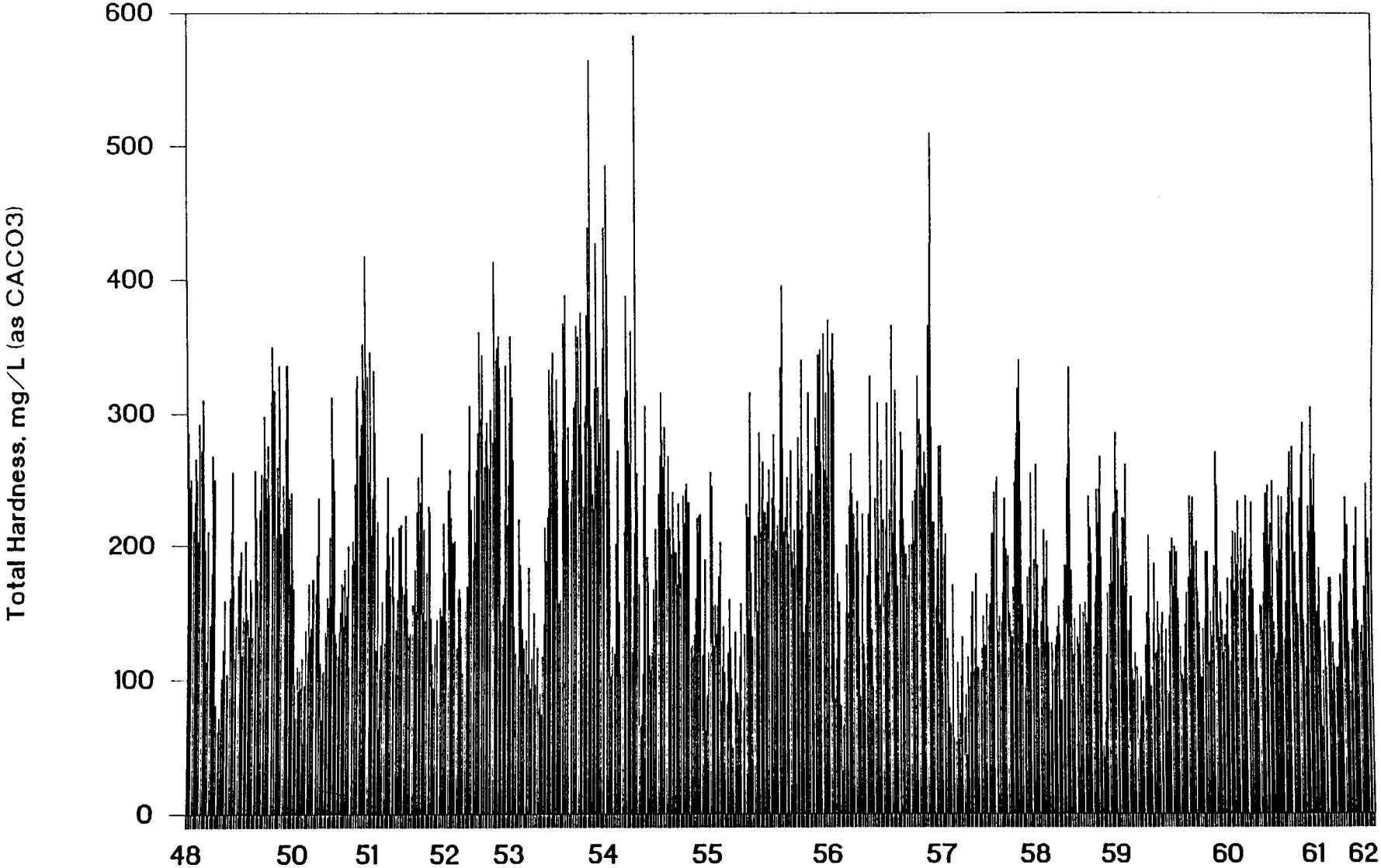

Figure 246. Graph of Total Hardness Versus Time For The Dardanelle Site 1948-1963.

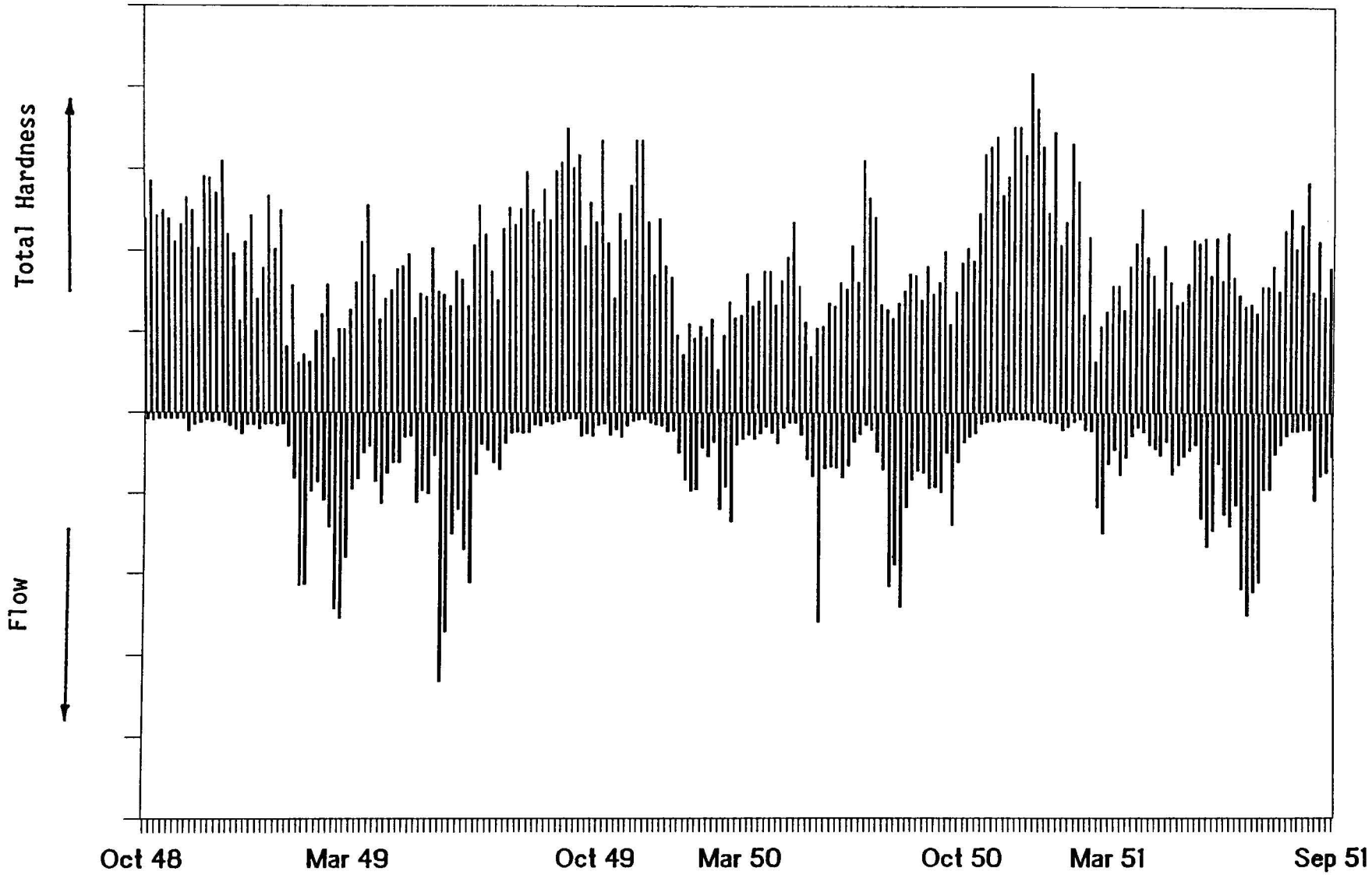

Figure 247. Graph of Total Hardness And Flow Versus Time For The Dardanelle Site 1948-1951.

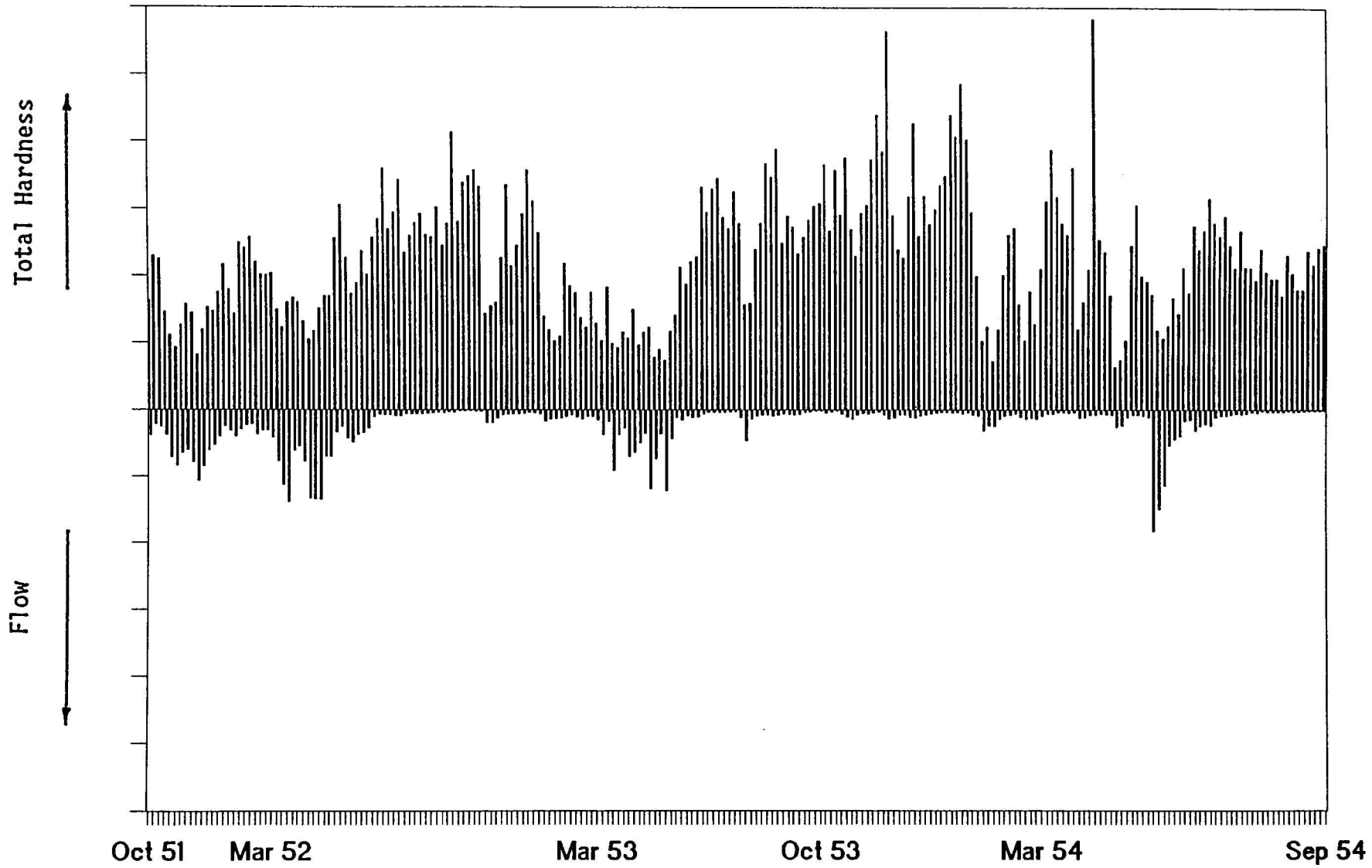

Figure 248. Graph of Total Hardness And Flow Versus Time For The Dardanelle Site 1951-1954.

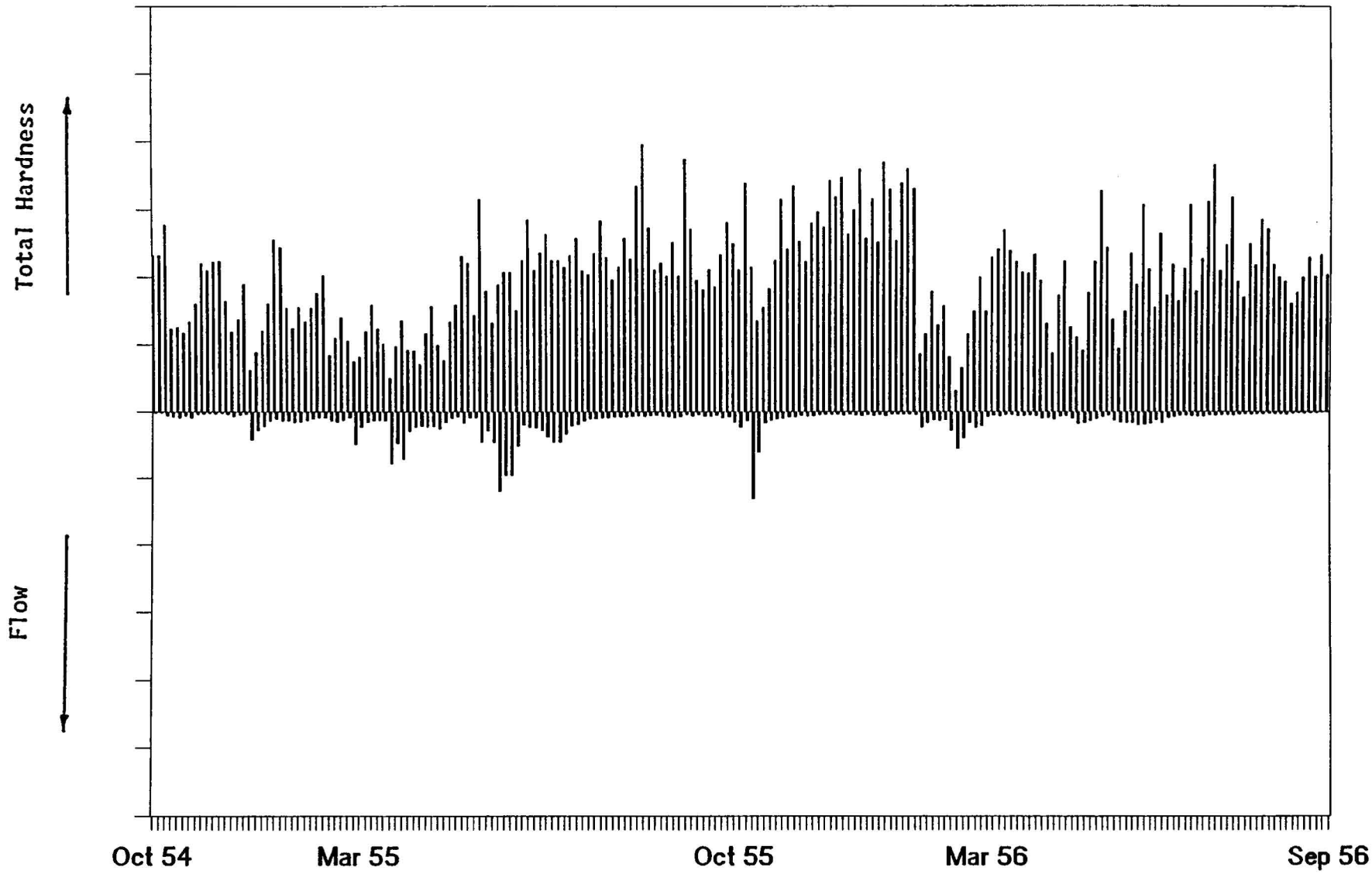

Figure 249. Graph of Total Hardness And Flow Versus Time For The Dardanelle Site 1954-1956.

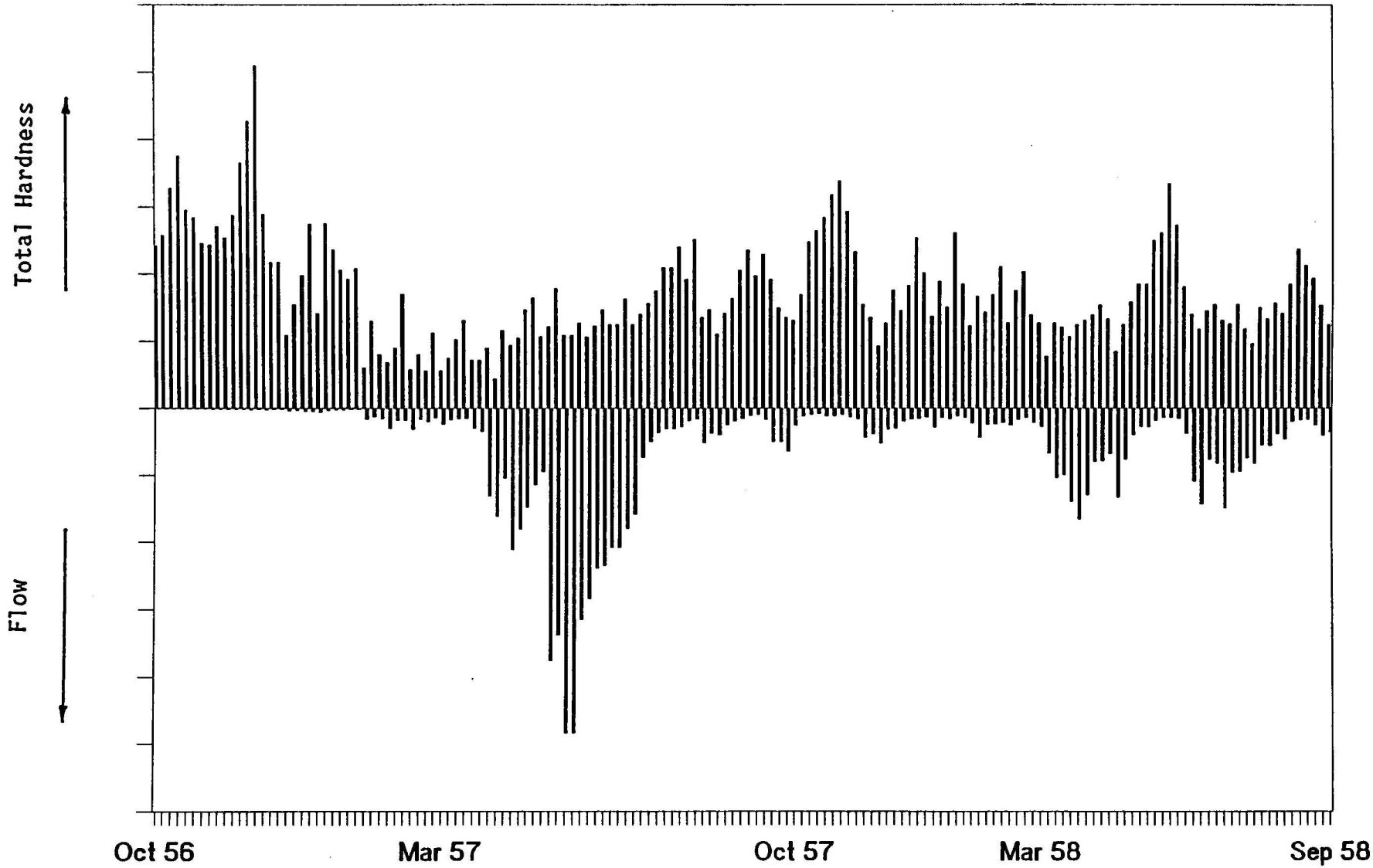

Figure 250. Graph of Total Hardness And Flow Versus Time For The Dardanelle Site 1956-1958.

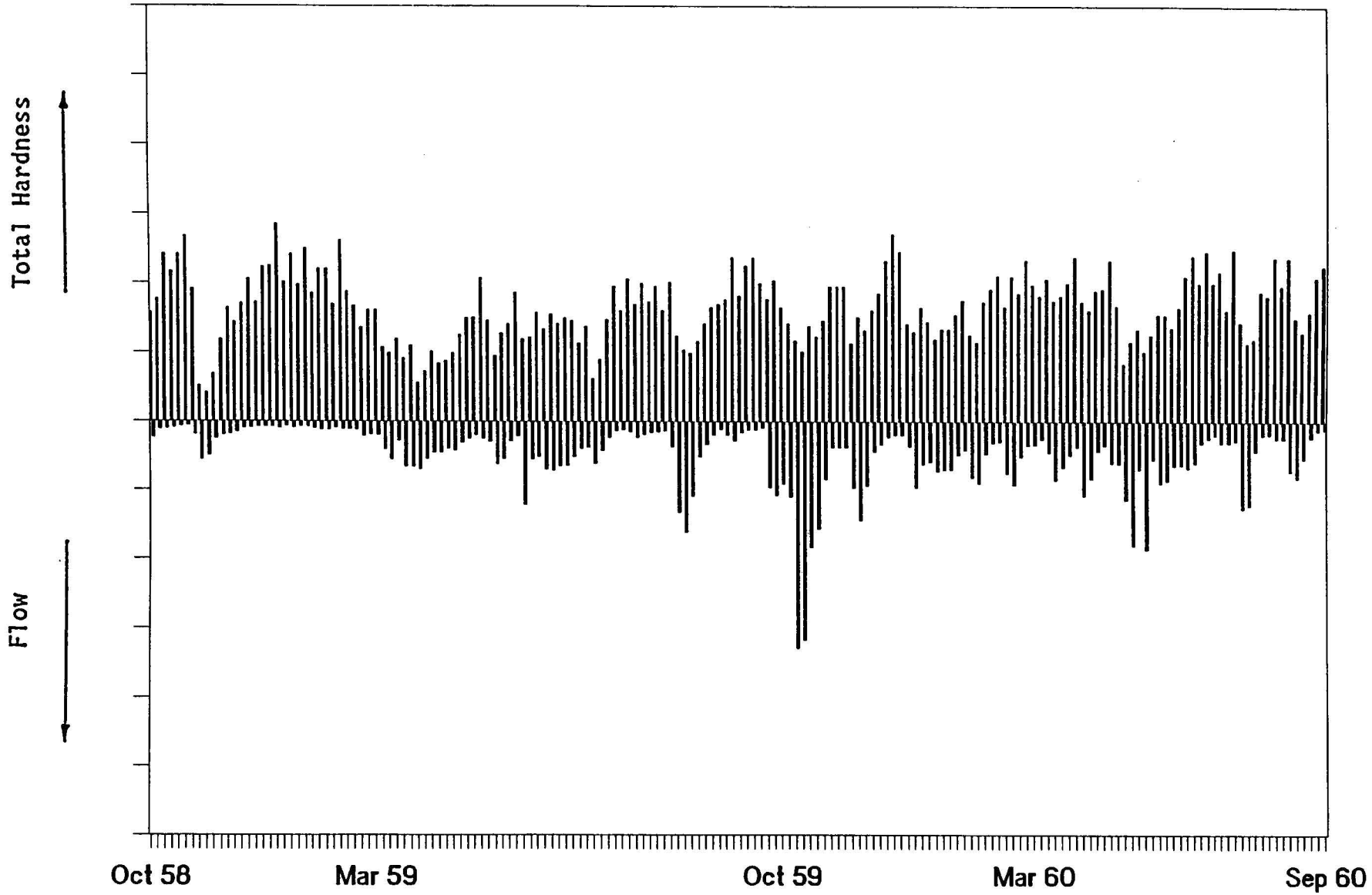

Figure 251. Graph of Total Hardness And Flow Versus Time For The Dardanelle Site 1958-1960.

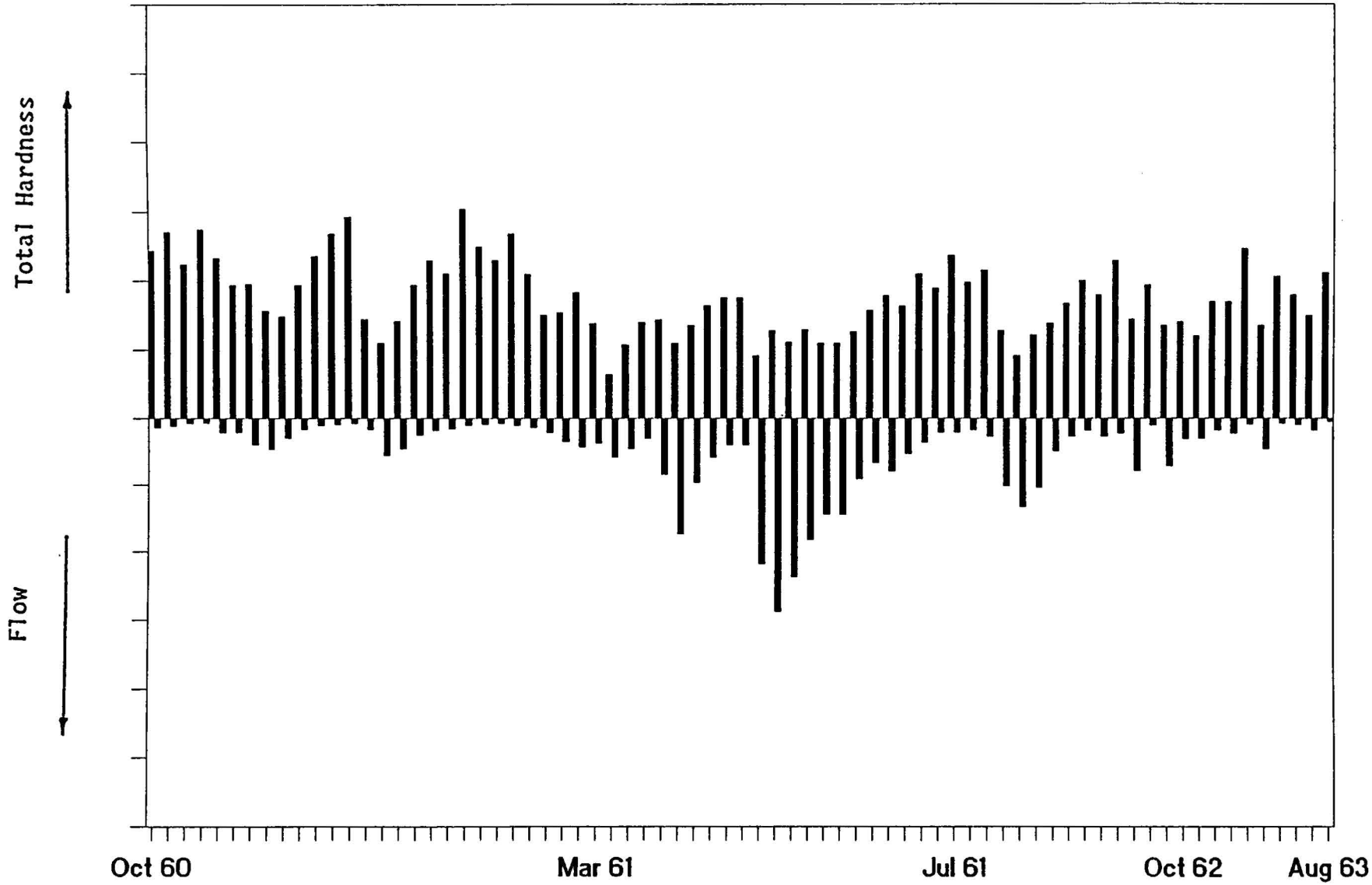

Figure 252. Graph of Total Hardness And Flow Versus Time For The Dardanelle Site 1960-1963.

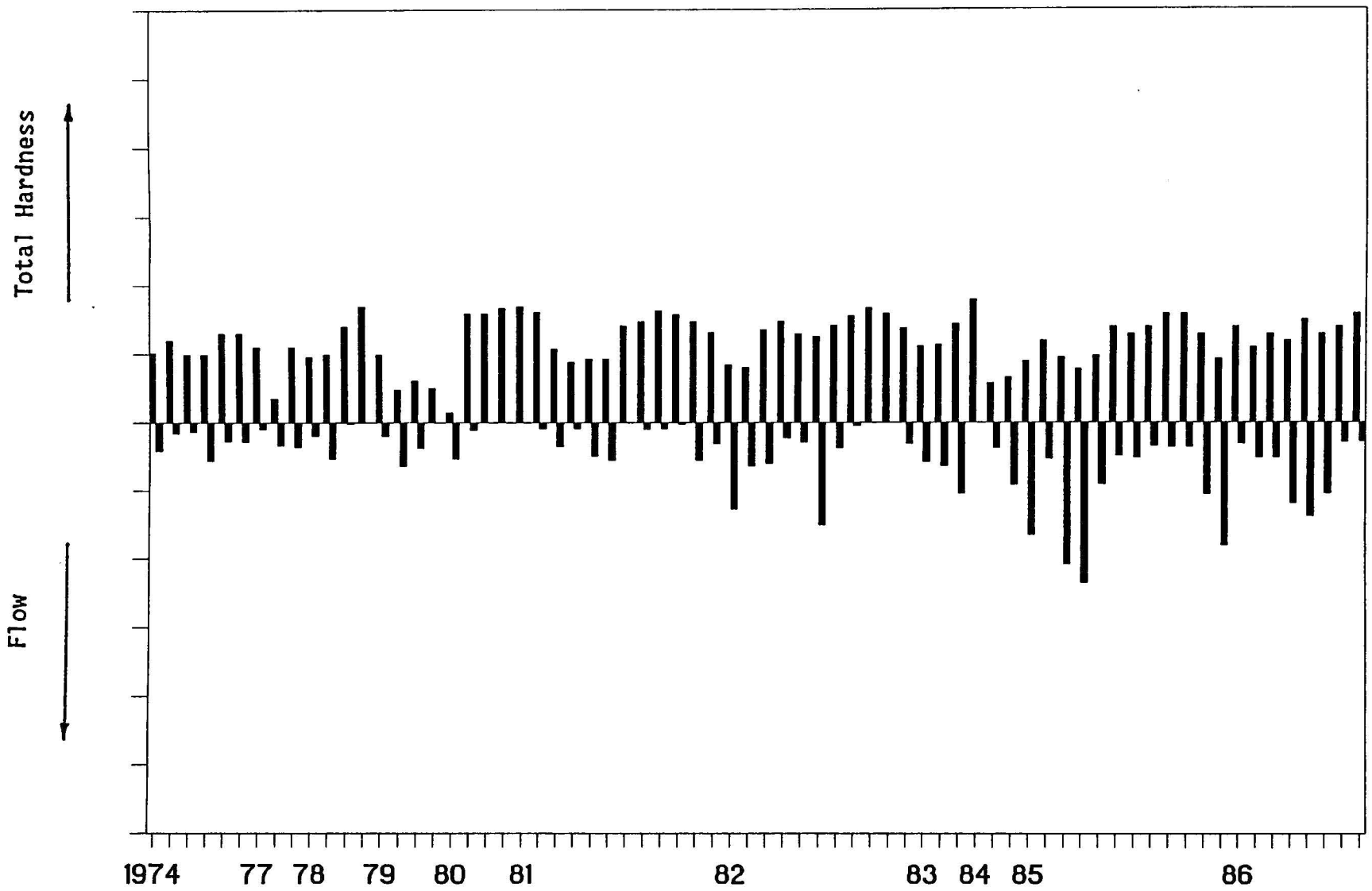

Figure 253. Graph of Total Hardness And Flow Versus Time For The Dardanelle Site 1974-1986.

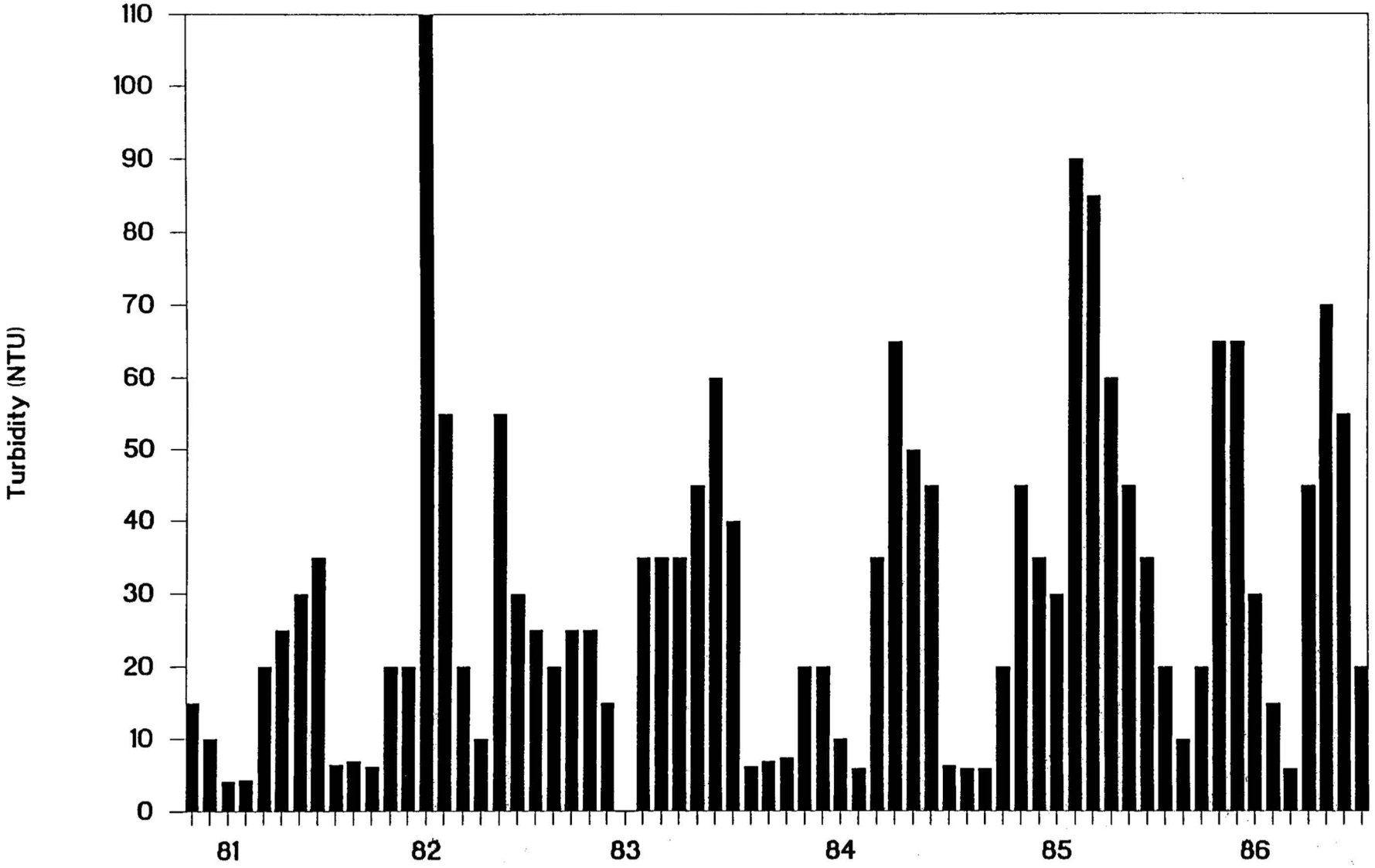

Figure 254. Graph of Turbidity Versus Time For The Dardanelle Site 1980-1986.

time in Figure 255. As would be expected, the turbidity values tended to be greater at the larger flow rates and smaller at lower flow rates.

Flow. Flow is plotted as a function of time in Figures 256 through 263. A composite graph of all data from 1948 until 1963 is included as Figure 264.

Conway (Toad Suck Ferry Lock And Dam)

The Toad Suck Ferry Lock and Dam sampling site is located 6.0 miles west of Conway at mile 172.0.

Chloride. Figure 264 shows the chloride concentrations graphically as a function of time for the Conway site from 1975 until 1986. The average concentration was 99 mg/L. The minimum and maximum concentrations were 12 and 340 mg/L, respectively. There were 116 values reported. Figure 265 shows both chloride and flow plotted as a function of time for this site. The chloride mass in tons per day is shown graphically in Figure 266.

Coliform. The average coliform count at the Conway site for the 132 values reported was 148 organisms per one hundred milliliters. The minimum and maximum concentrations were 4 and 4,000 organisms per one hundred milliliters. The data are shown in Figures 267 and 268. Figure 267 shows the coliform counts plotted versus time. Both flow and coliform counts are plotted in Figure 268. The record included 148 concentrations for the period from 1974 until 1986.

Dissolved Solids. The period of record for dissolved solids extended from 1977 until 1986 and included 93 concentrations. The average concentration was 330 mg/L. The minimum

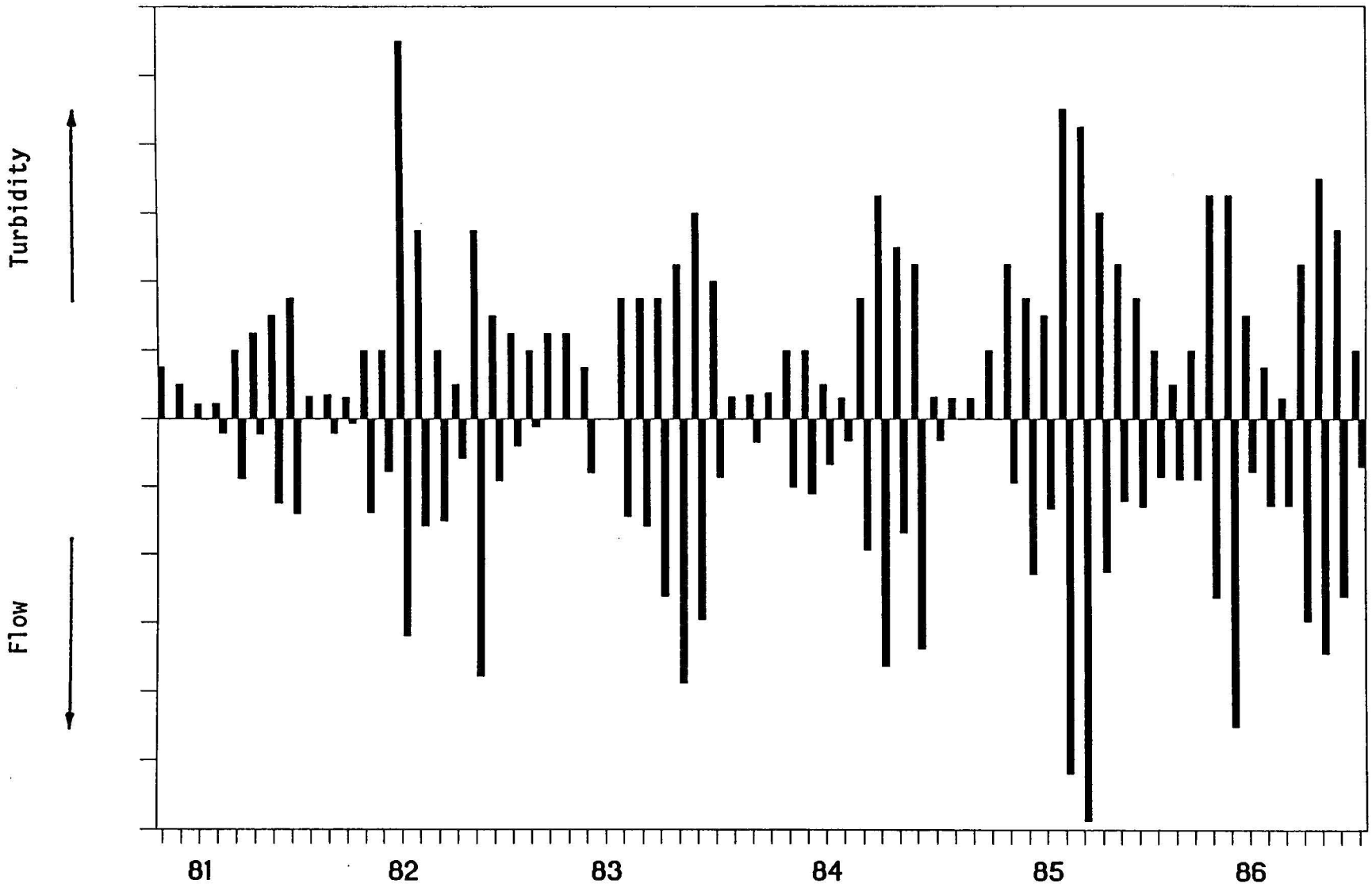

Figure 255. Graph of Turbidity & Flow Versus Time For The Dardanelle Site 1980-1986.

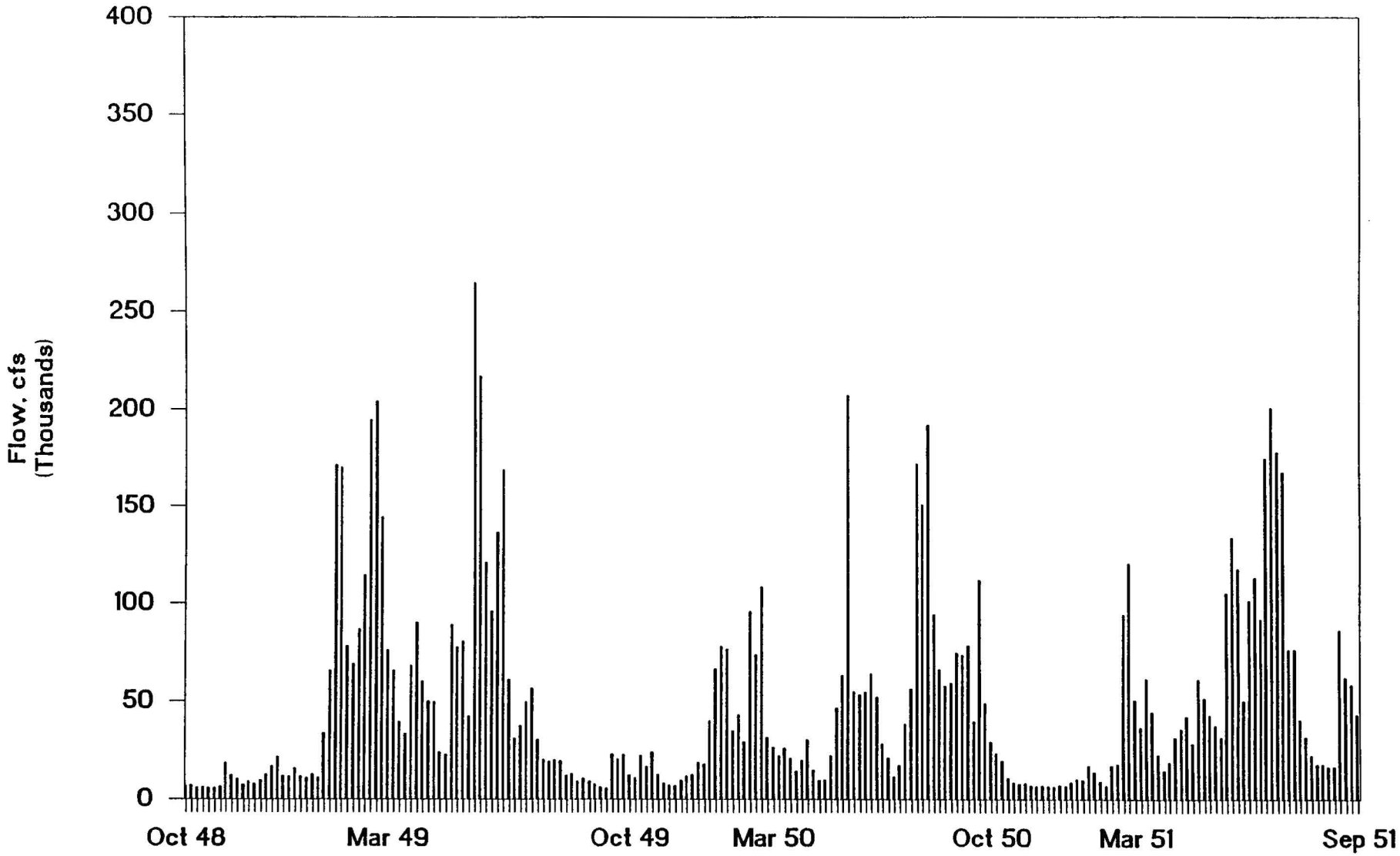

Figure 256. Graph of Flow Versus Time For The Dardanelle Site 1948-1951.

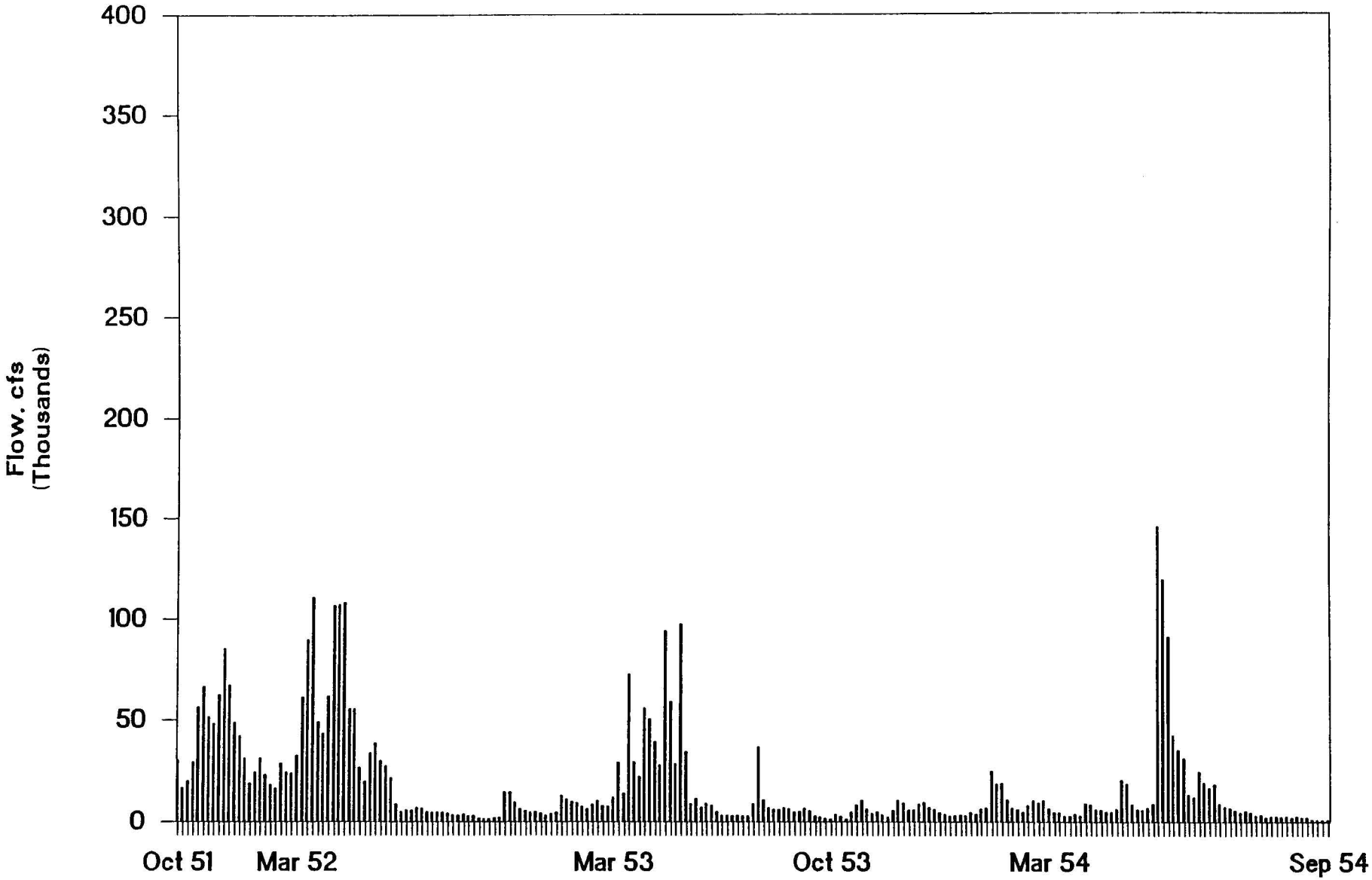

Figure 257. Graph of Flow Versus Time For The Dardanelle Site 1951-1954.

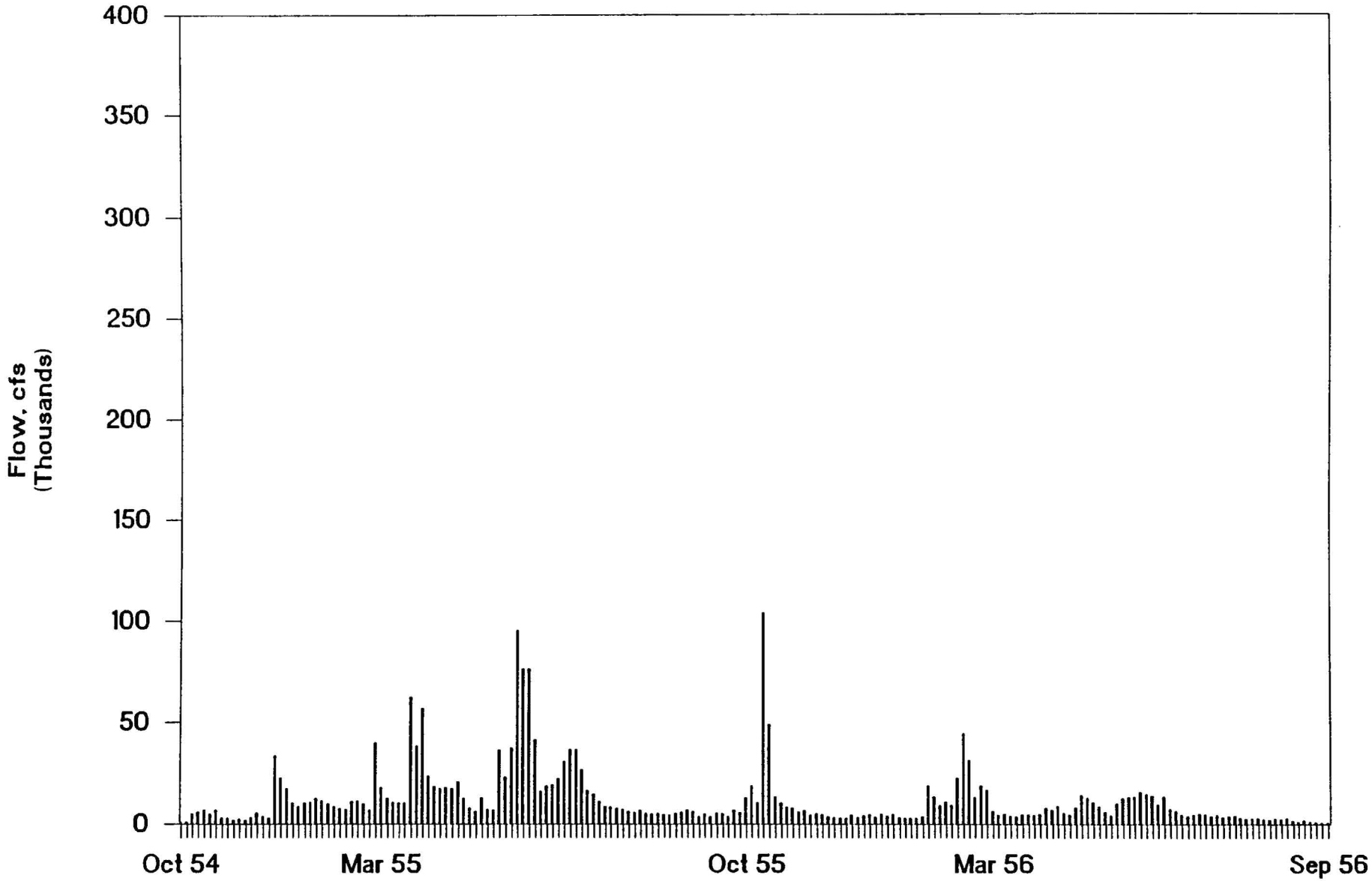

Figure 258. Graph of Flow Versus Time For The Dardanelle Site 1954-1956.

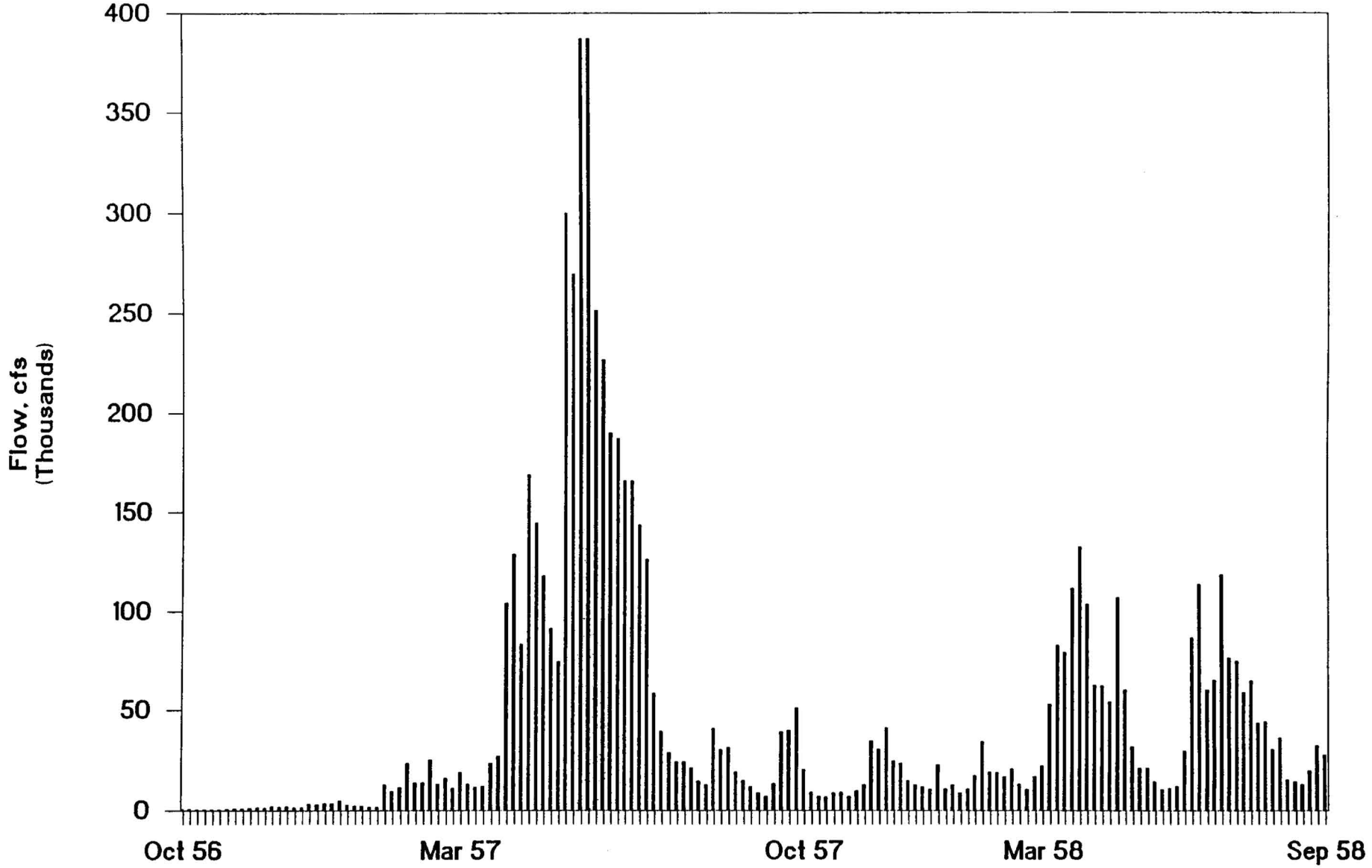

Figure 259. Graph of Flow Versus Time For The Dardanelle Site 1956-1958.

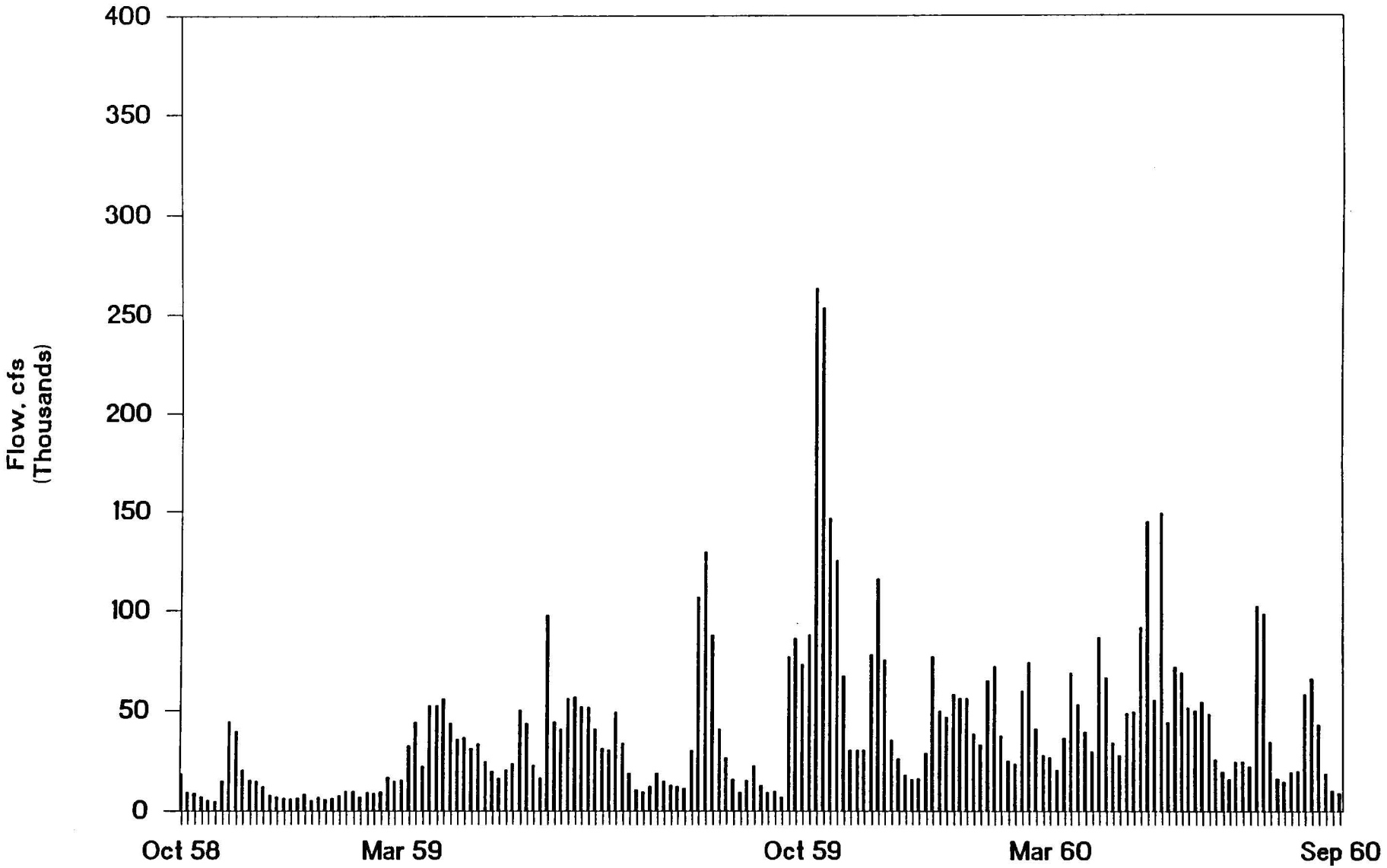

Figure 260. Graph of Flow Versus Time For The Dardanelle Site 1958-1960.

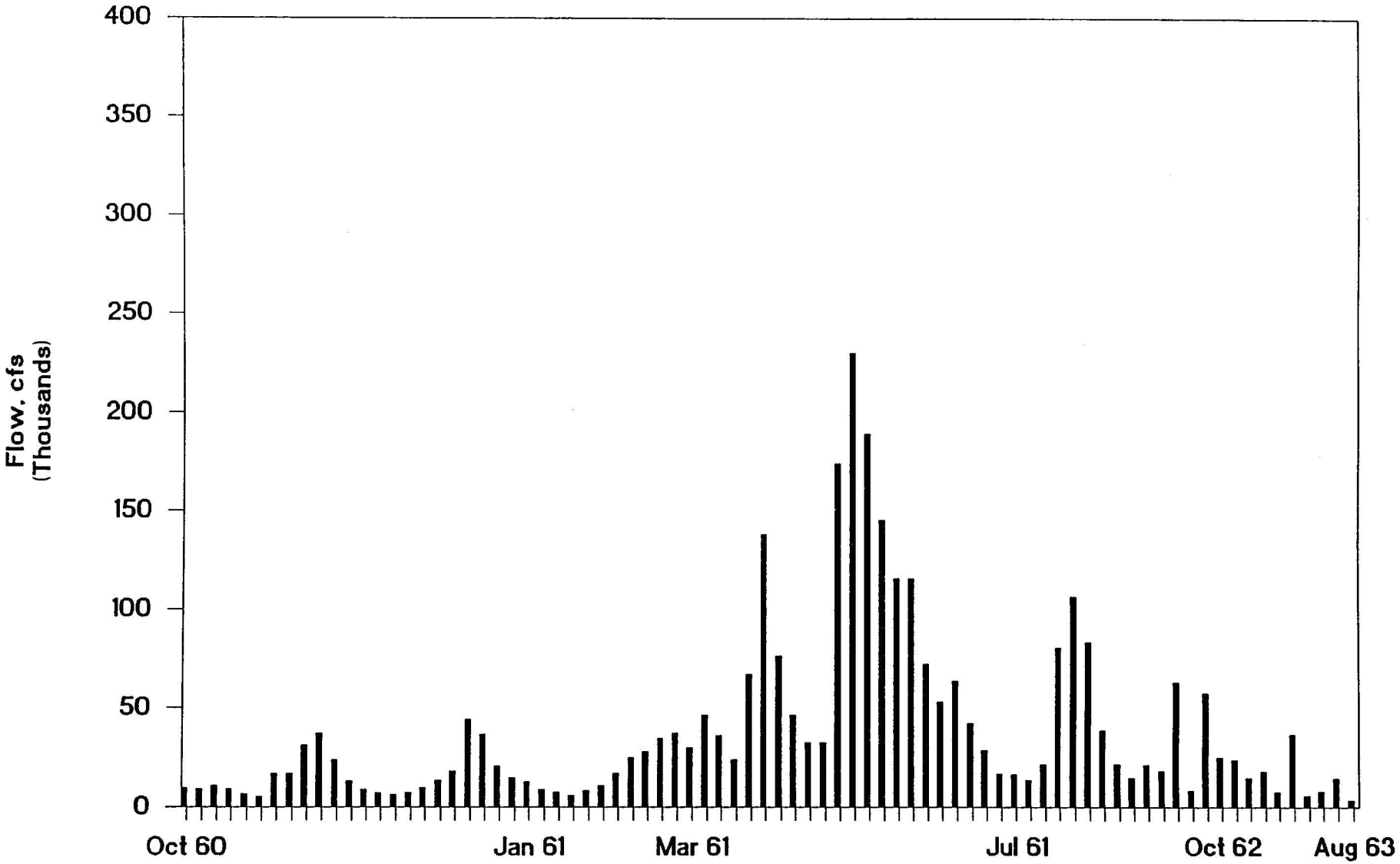

Figure 261. Graph of Flow Versus Time For The Dardanelle Site 1960-1963.

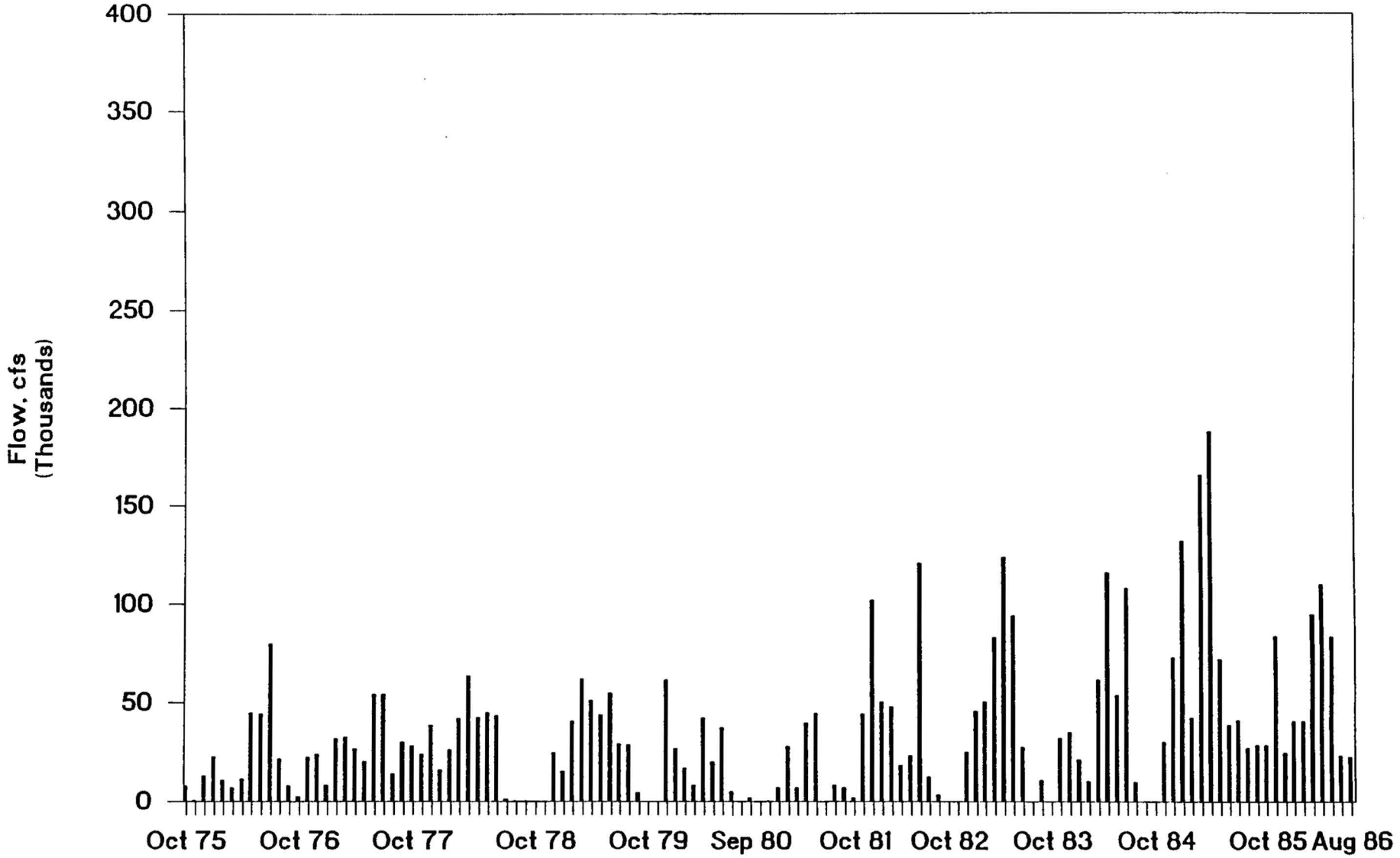

Figure 262. Graph of Flow Versus Time For The Dardanelle Site 1974-1986.

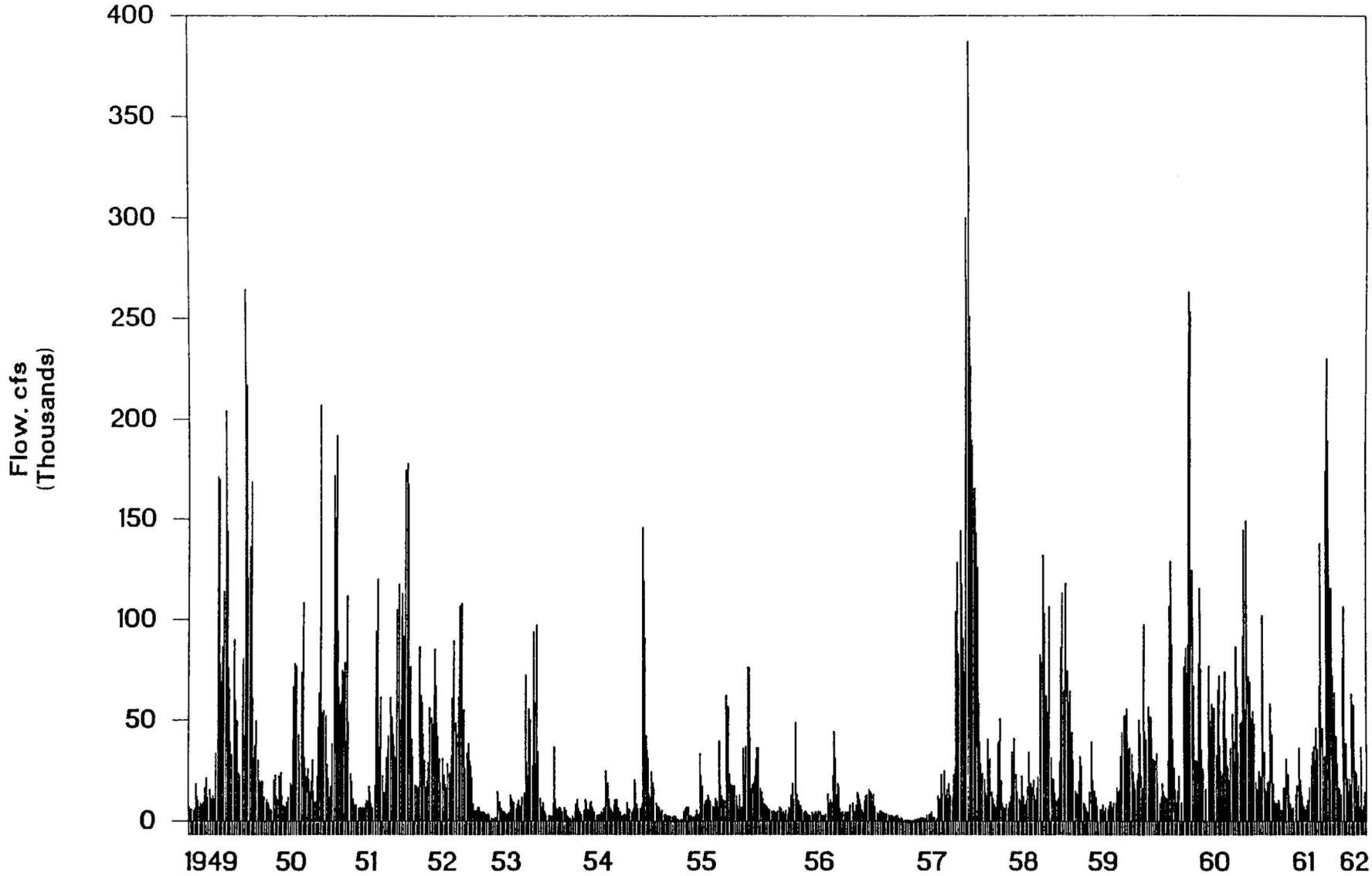

Figure 263. Graph of Flow Versus Time For The Dardanelle Site 1948-1963.

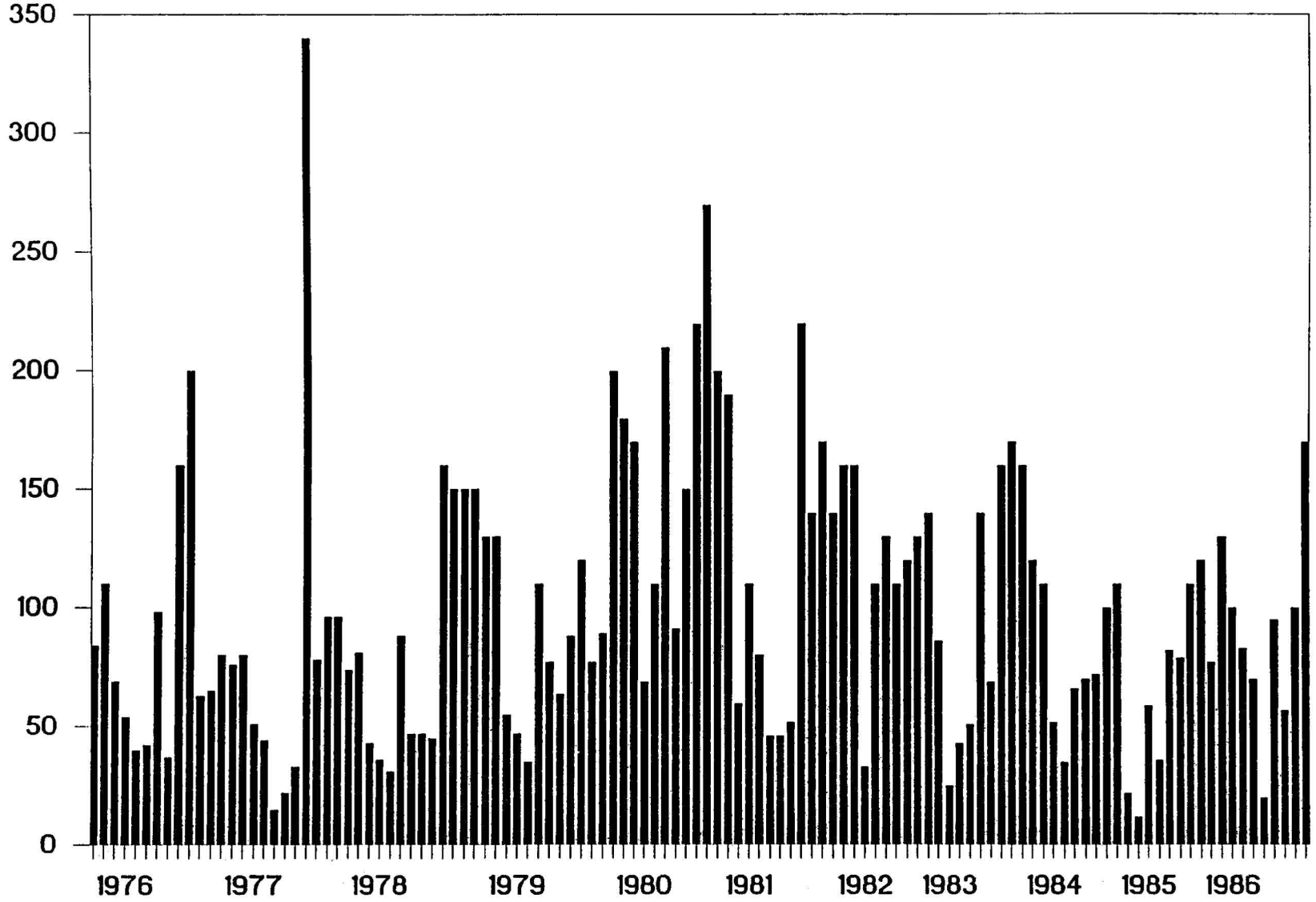

Figure 264. Graph of Chloride Versus Time For The Toad Suck Ferry Lock And Dam Site.

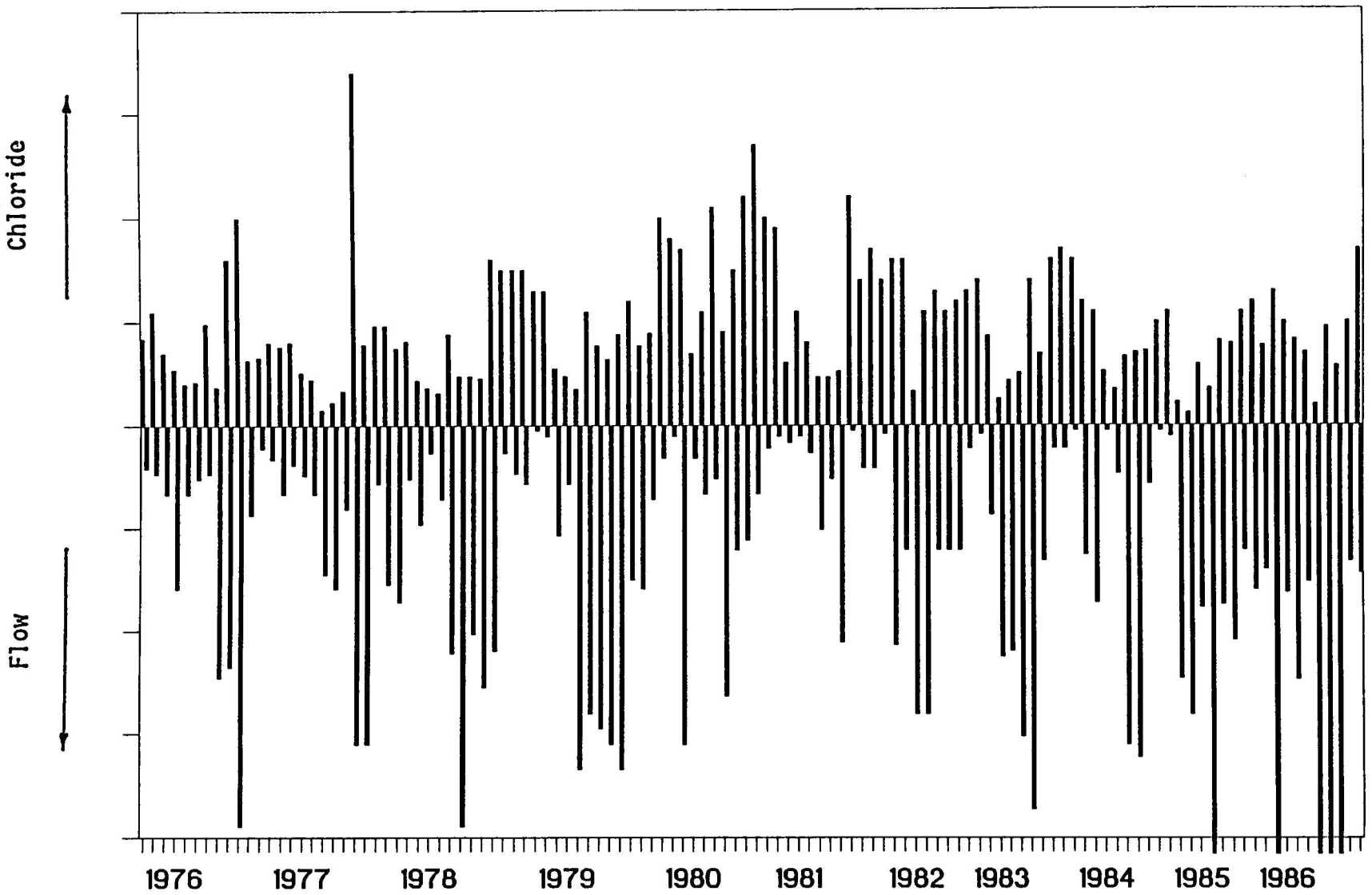

Figure 265. Graph of Chloride And Flow Versus Time For The Toad Suck Ferry Lock And Dam Site.

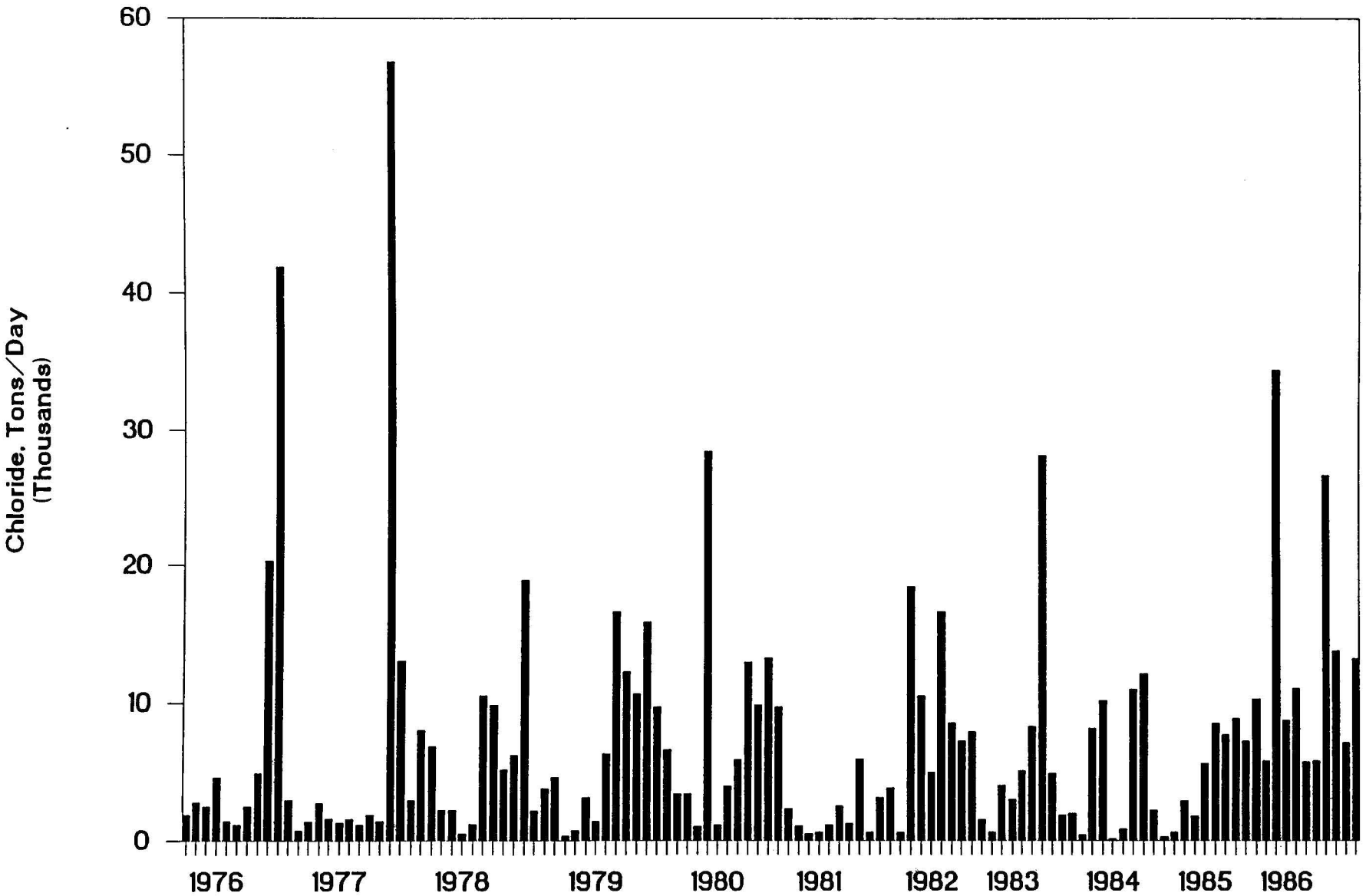

Figure 266. Graph of Chloride (Tons Per Day) Versus Time For The Toad Suck Ferry Lock And Dam Site.

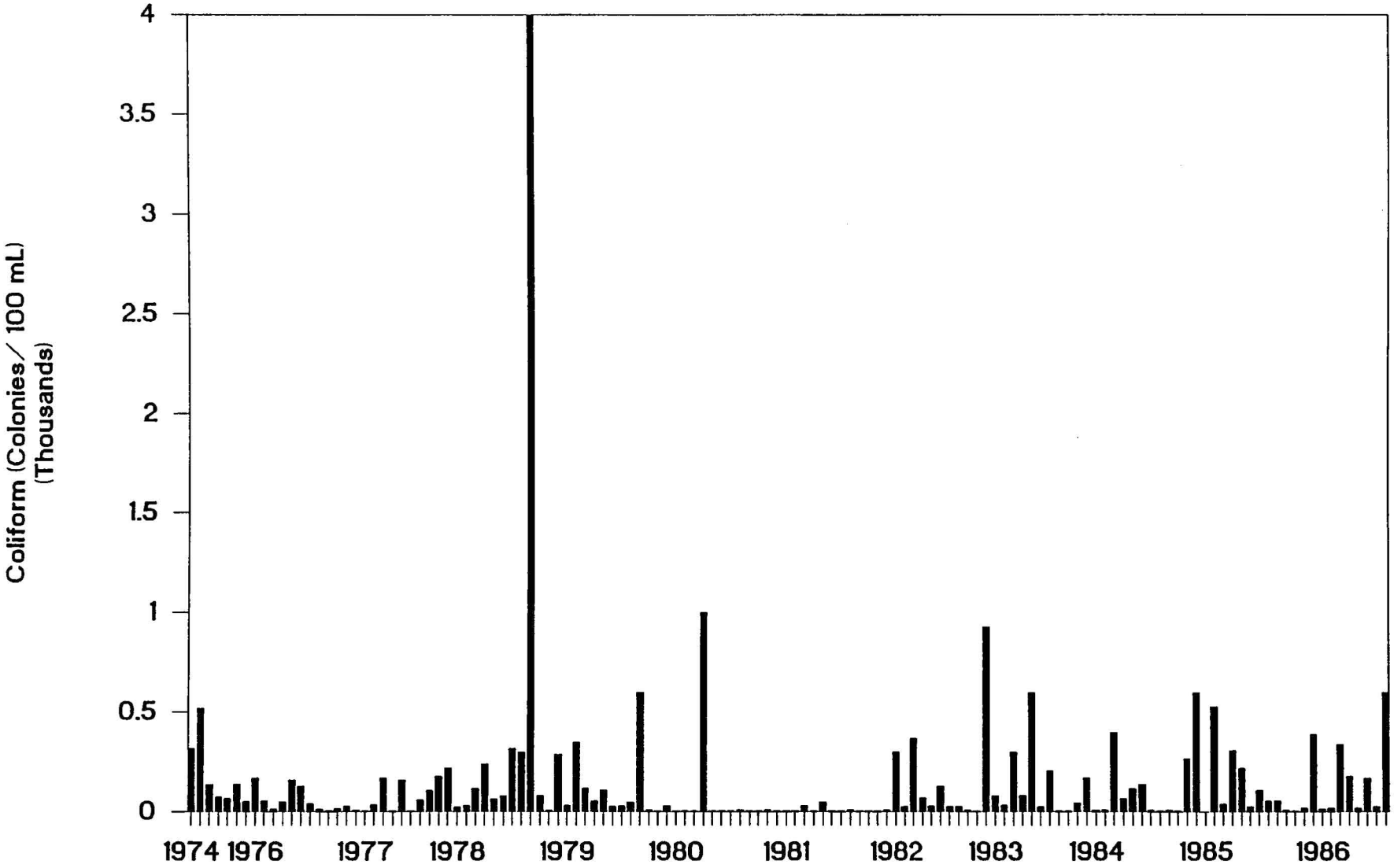

Figure 267. Graph of Coliform Versus Time For The Toad Suck Ferry Lock And Dam Site.

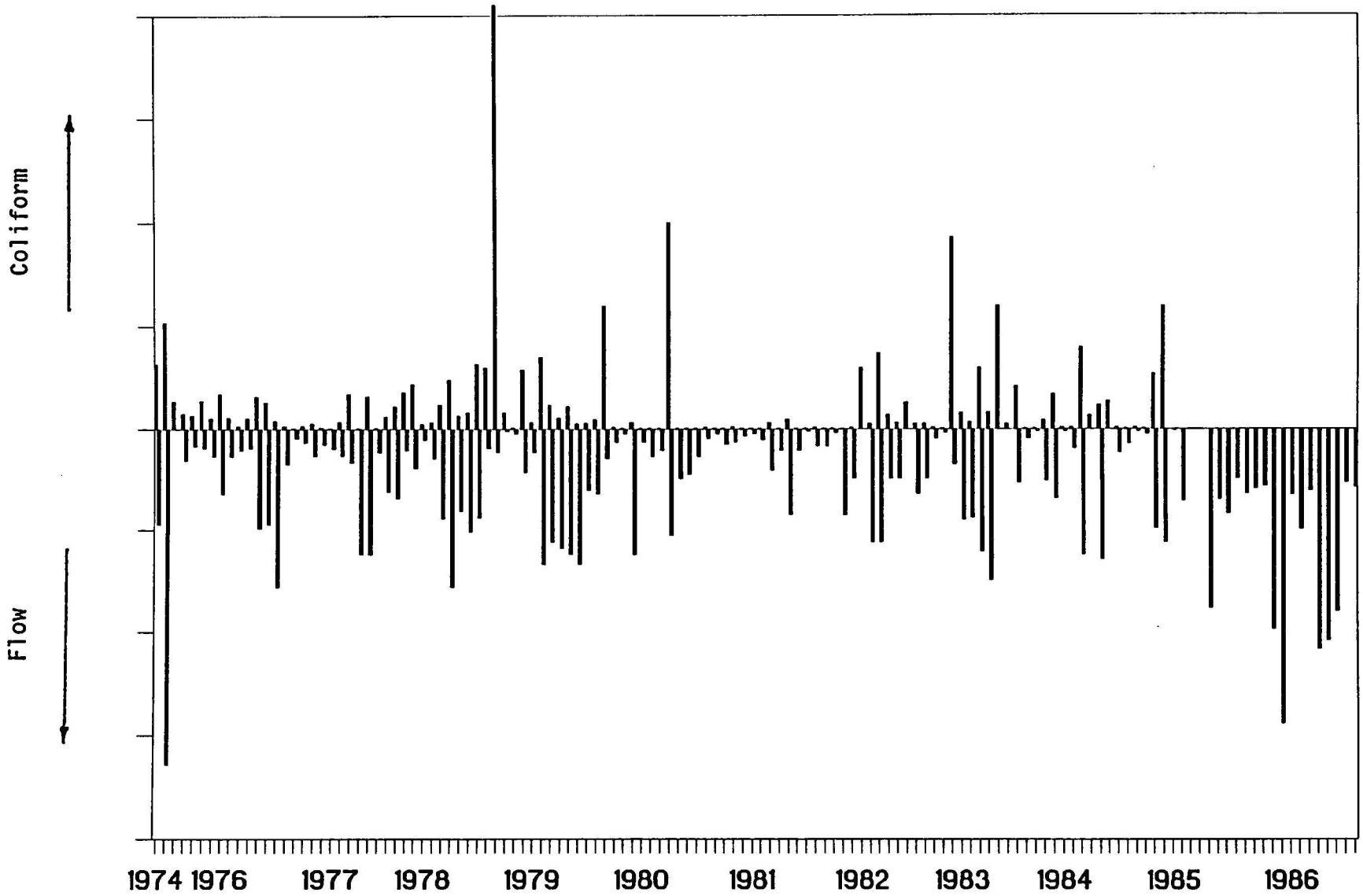

Figure 268. Graph of Coliform And Flow Versus Time For The Toad Suck Ferry Lock And Dam Site.

and maximum concentrations were 52 and 581 mg/L. The data are plotted as a function of time in Figure 269. Figure 270 shows both flow and dissolved solids plotted versus time for this site.

pH. The average pH value for the 128 values included in the record from 1974 until 1986 was 7.9. The minimum and maximum values were 6.9 and 8.9, respectively.

Potassium. The average potassium concentration was 3.5 mg/L with the concentrations ranging from 0.6 to 5.0 mg/L. The period of record was from 1974 until 1980 and included 20 concentrations.

Suspended Solids. The suspended solids concentrations ranged from 0 to 160 mg/L with an average concentration of 31 mg/L. The period of record was from 1974 until 1986. One hundred thirty-two data points were included in the record. Figure 271 shows the suspended solids data as a function of time for this site. Both flow and suspended solids concentrations are shown in Figure 272.

Sulfate. The period of record for sulfate data also extended from 1974 until 1986. The record included 125 values for sulfate. The average concentration was 40 mg/L with the concentrations ranging from 1 to 82 mg/L. The sulfate data is shown in Figures 273 and 274. The latter figure includes both flow and sulfate versus time.

Total Hardness. The average total hardness concentration was 109 mg/L for the 71 values reported from 1974 until 1986. The minimum and maximum concentrations were 24 and 180 mg/L, respectively. The data are shown in Figure 275.

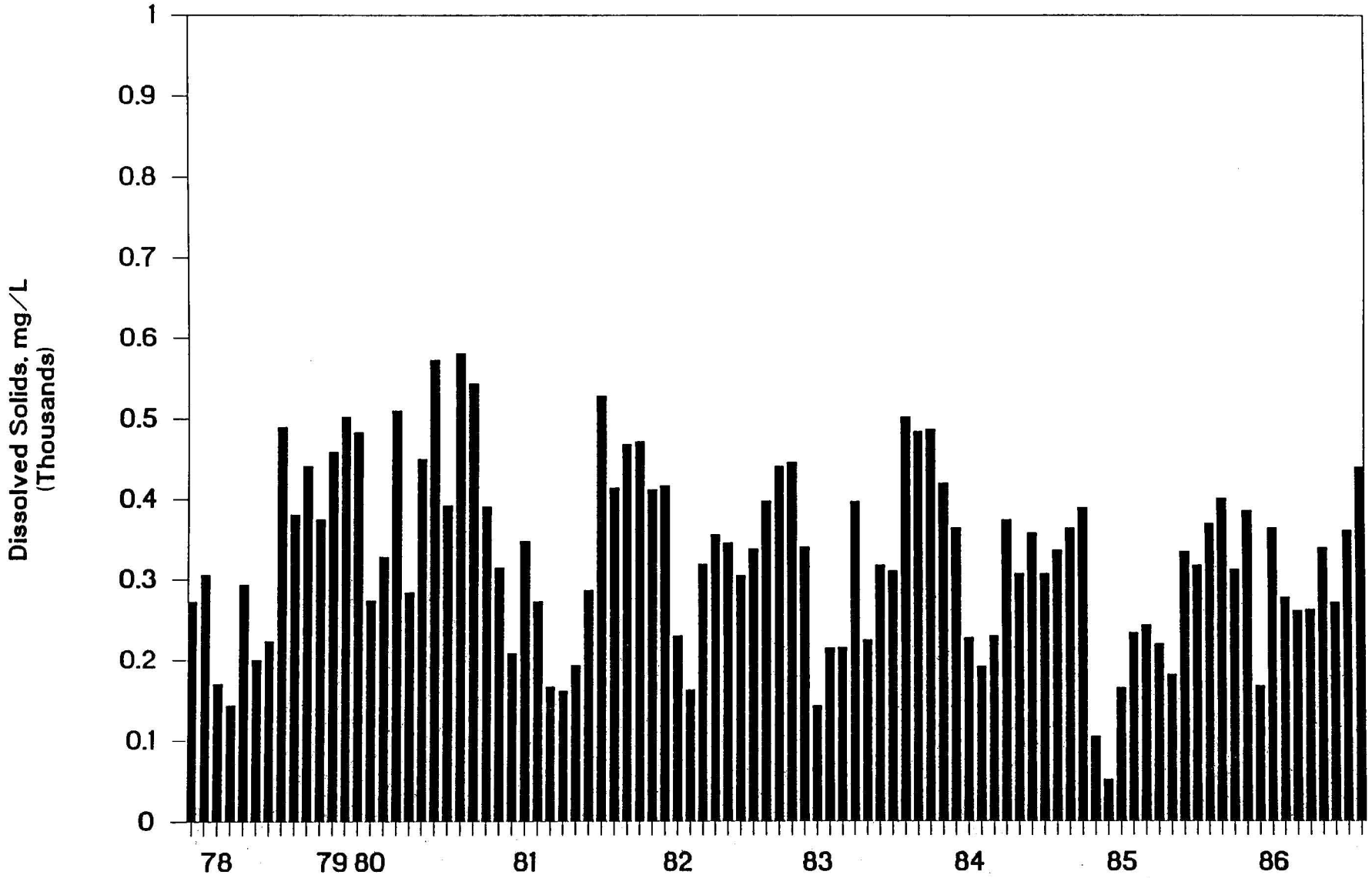

Figure 269. Graph of Dissolved Solids Versus Time For The Toad Suck Ferry Lock And Dam Site.

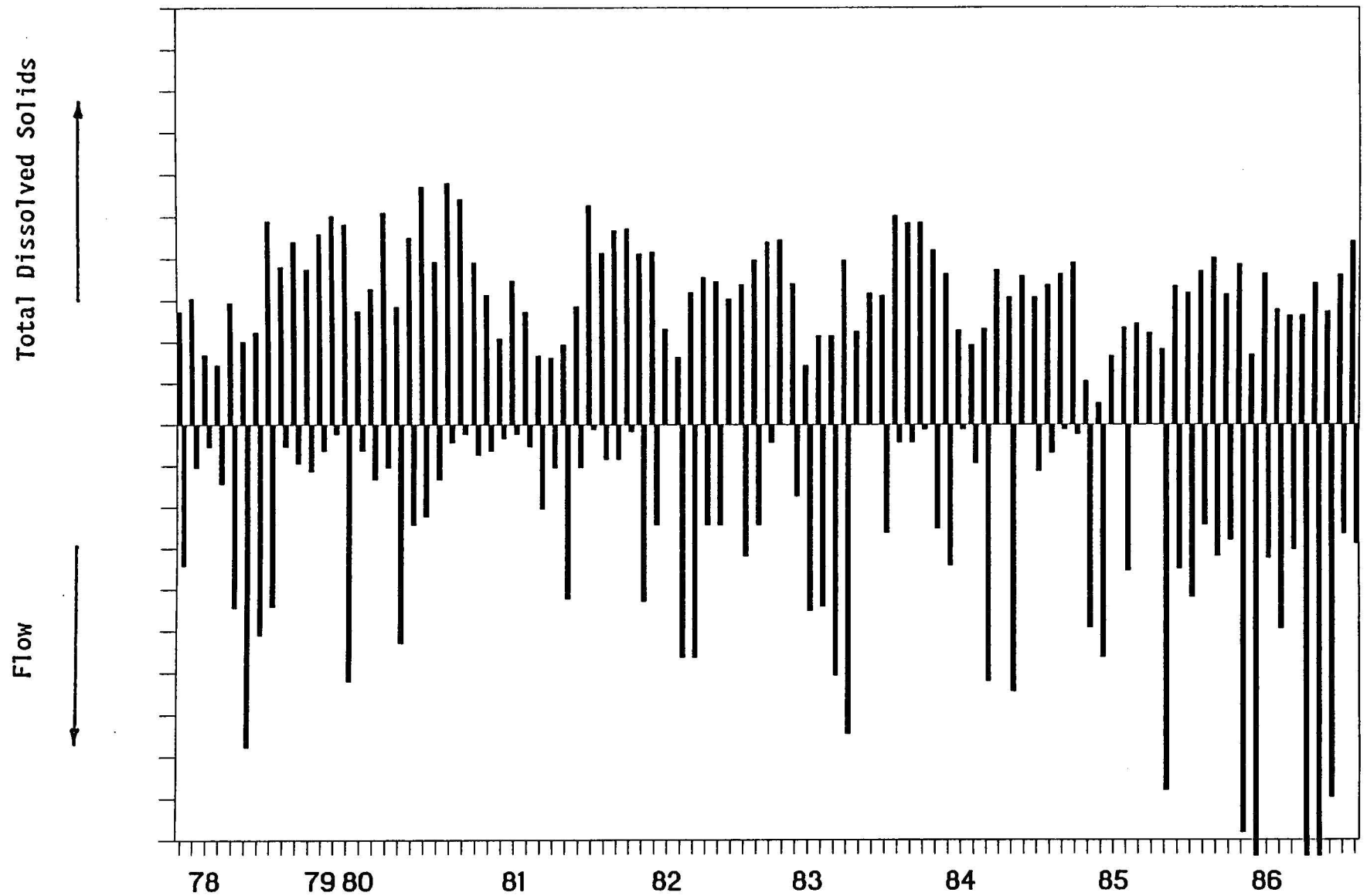

Figure 270. Graph of Dissolved Solids And Flow Versus Time For The Toad Suck Ferry Lock And Dam Site.

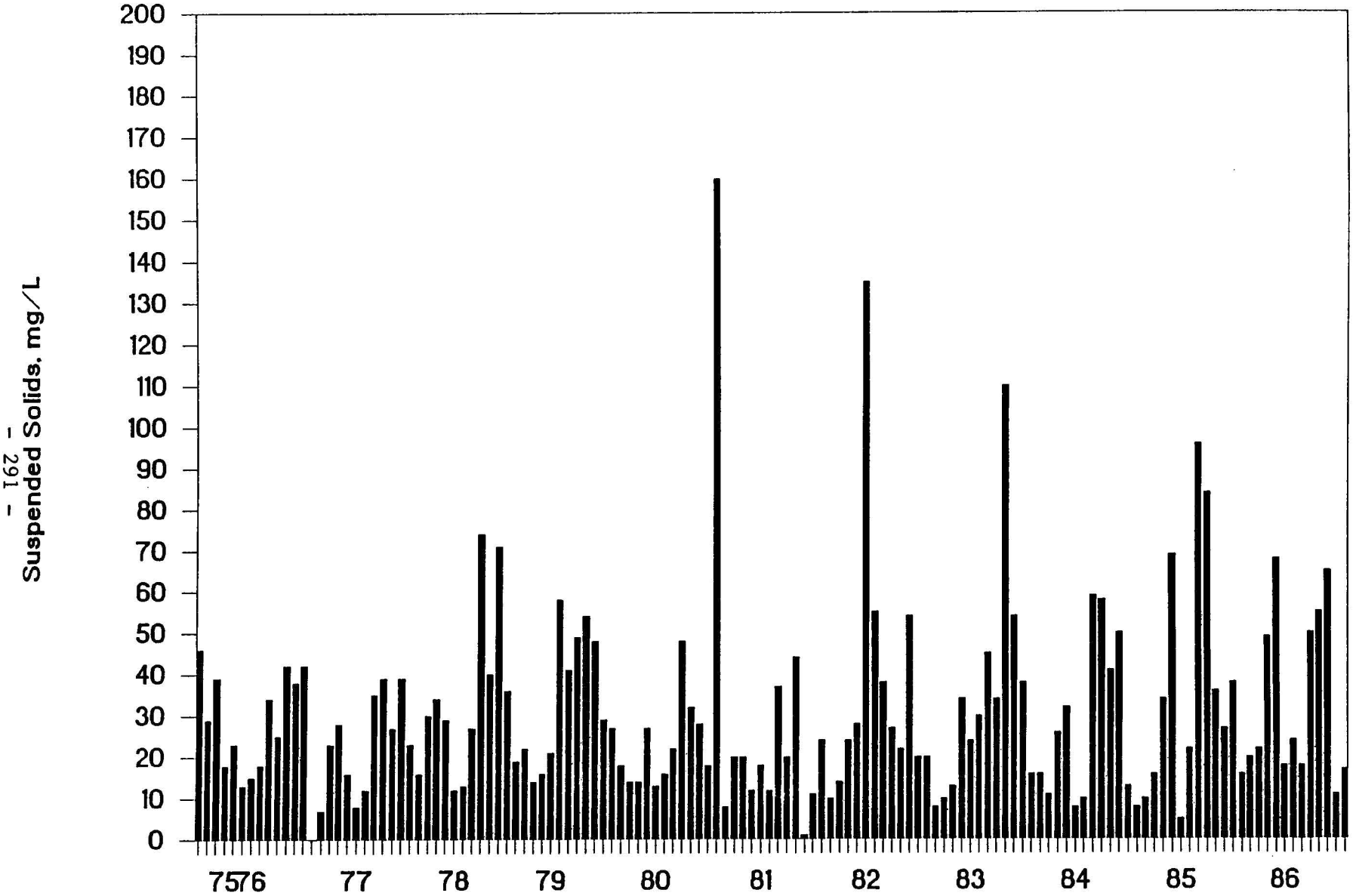

Figure 271. Graph of Suspended Solids Versus Time For The Toad Suck Ferry Lock And Dam Site.

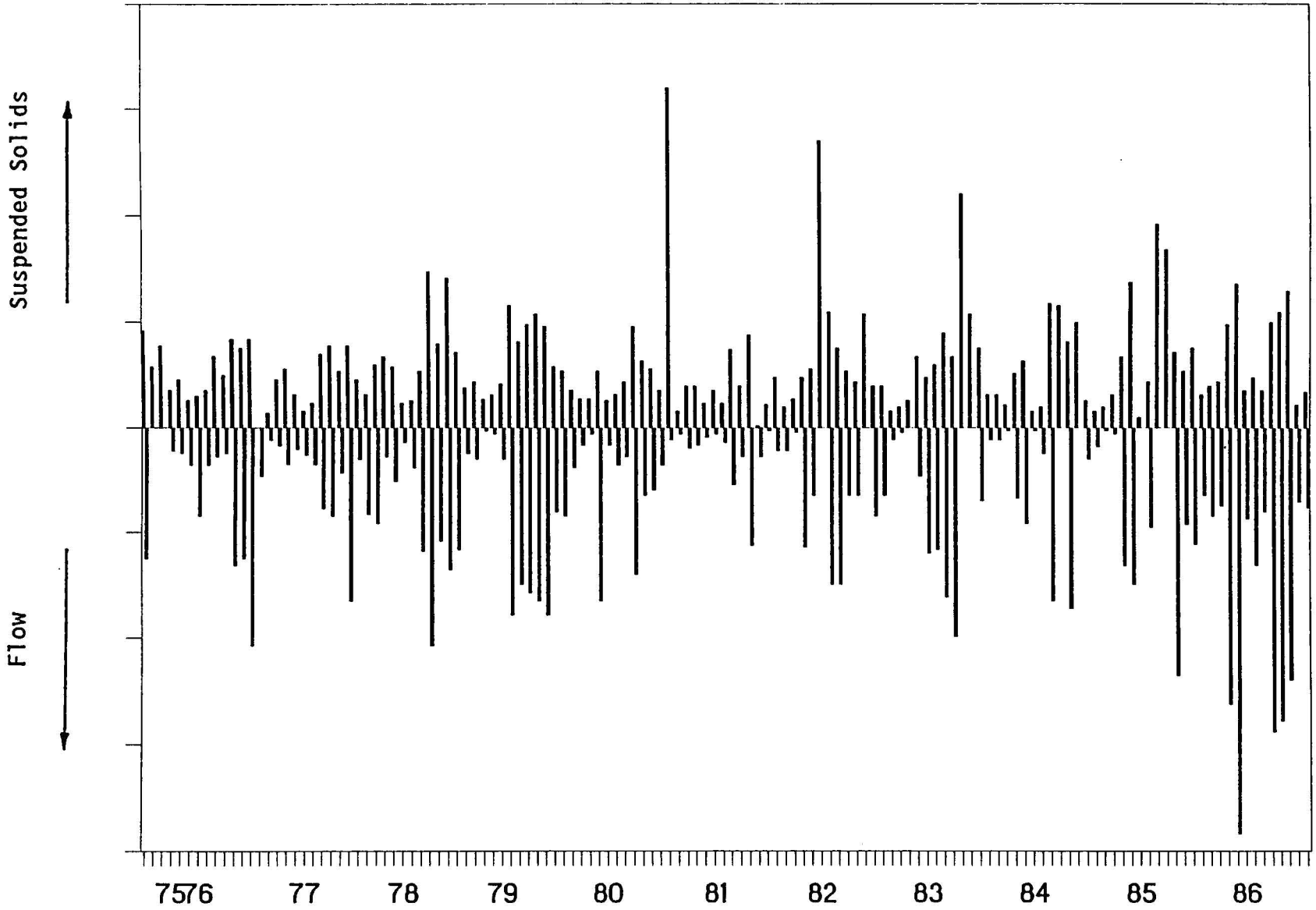

Figure 272. Graph of Suspended Solids And Flow Versus Time For The Toad Suck Ferry Lock And Dam Site.

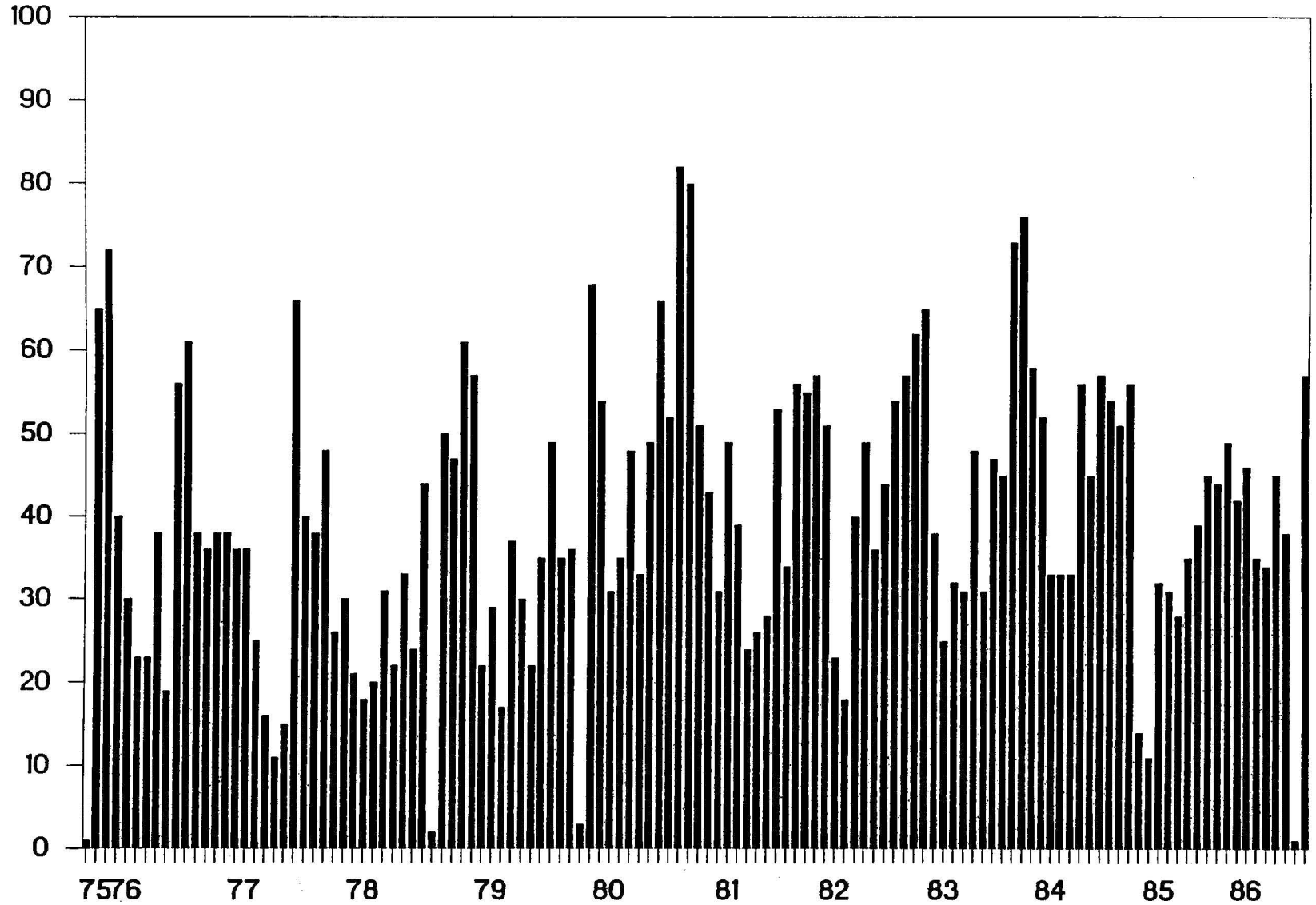

Figure 273. Graph of Sulfate Versus Time For The Toad Suck Ferry Lock And Dam Site.

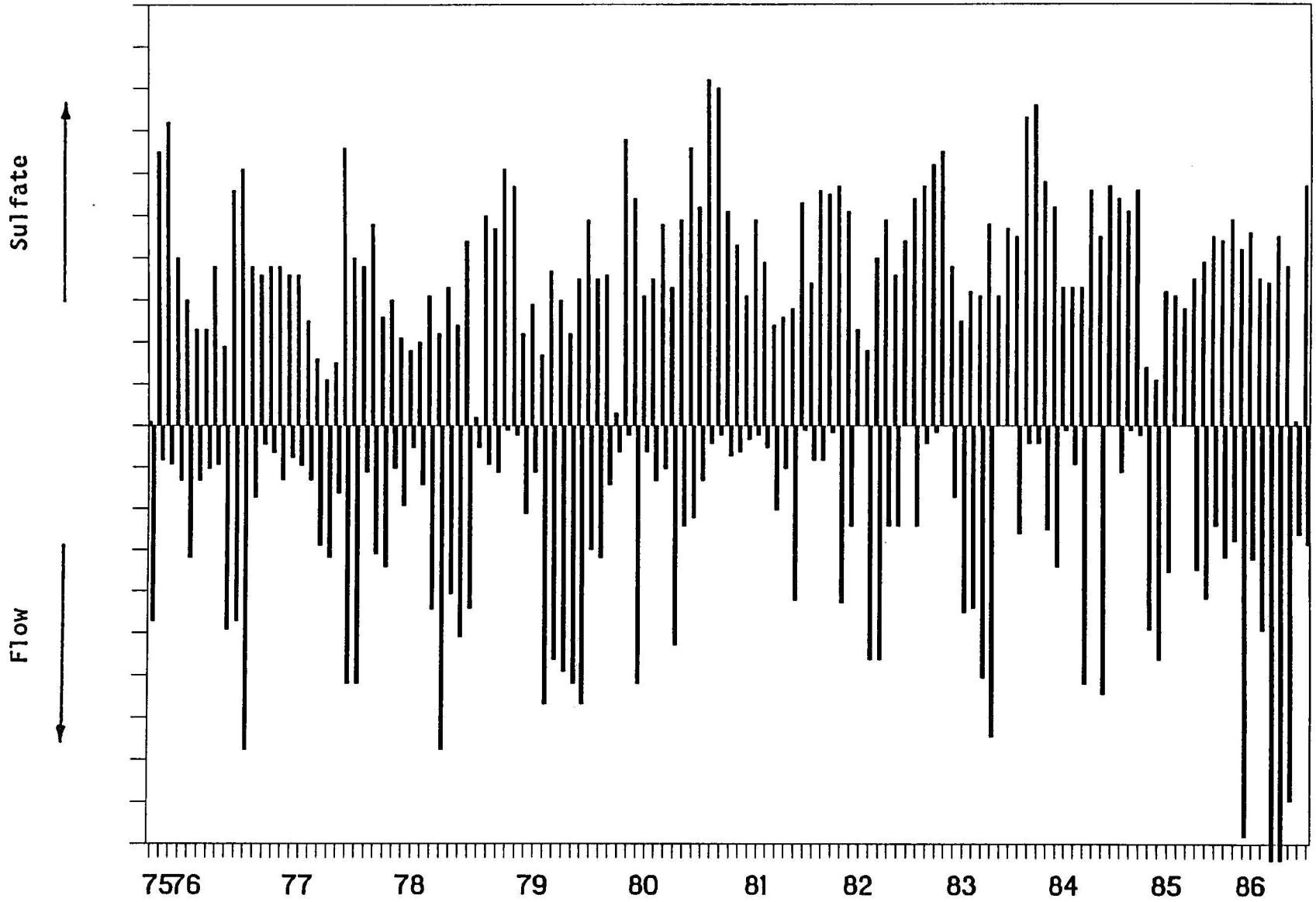

Figure 274. Graph of Sulfate And Flow Versus Time For The Toad Suck Ferry Lock And Dam Site.

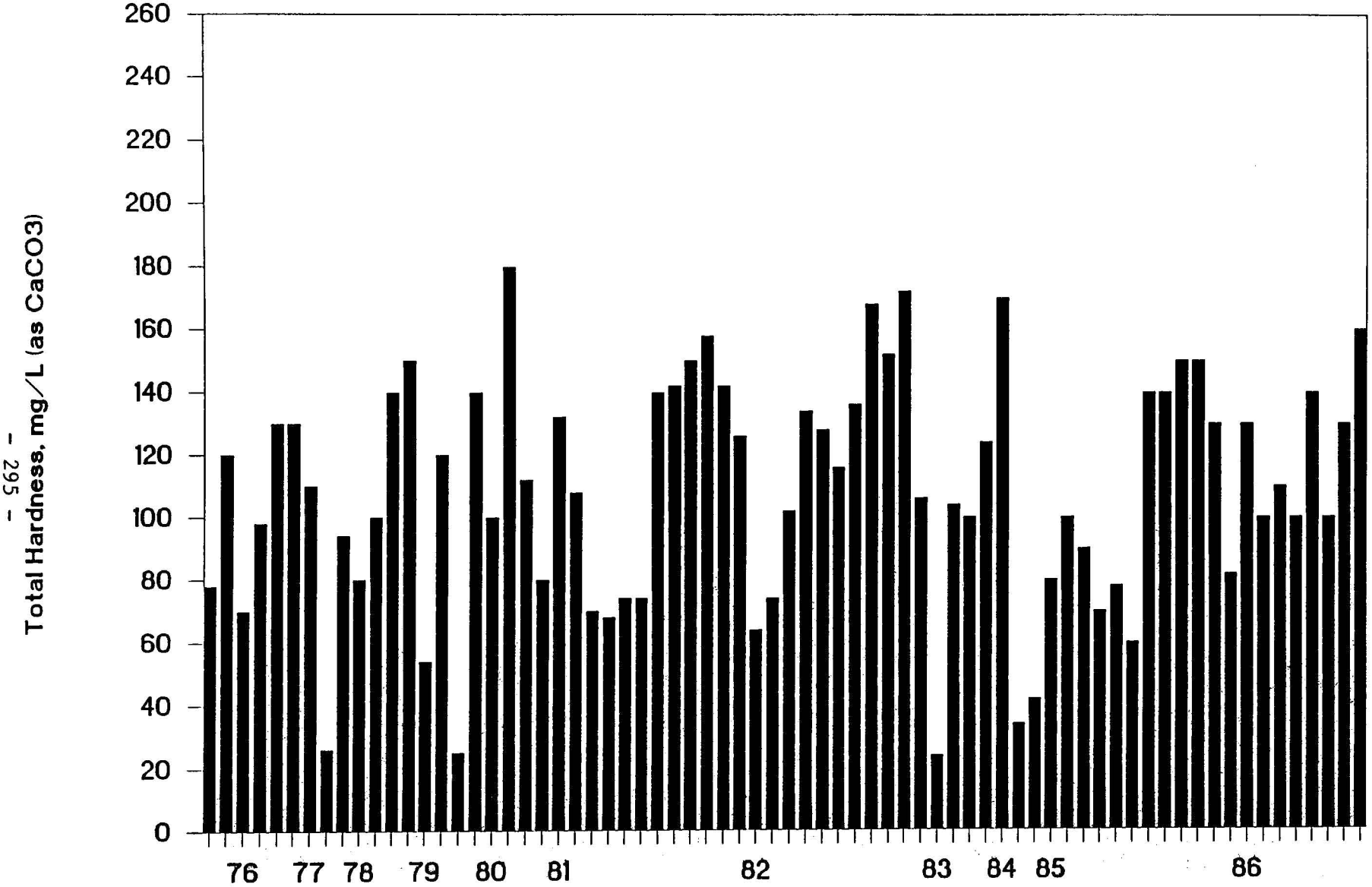

Figure 275. Graph of Total Hardness Versus Time For The Toad Suck Ferry Lock And Dam Site.

Figure 276 includes both flow and total hardness plotted as a function of time.

Turbidity. The average turbidity value for the sixty-five values included in the record was 33 turbidity units. The values ranged from 5 to 120 units. The period of record was from 1980 until 1986. Figure 277 shows turbidity as a function of time for this site. Both flow and turbidity are plotted in Figure 278.

Little Rock (Murray Dam)

The sampling site is located in the control house at Murray Dam on the right bank of the river. The sampling site is at mile 141.5.

Alkalinity. The average alkalinity concentration at this site was 85 mg/L (as $CaCO_3$). The minimum and maximum concentrations were 50 and 115 mg/L, respectively. The period of record was from 1975 until 1980. The record included 15 concentrations. The alkalinity data are shown in Figure 279.

Chloride. The chloride concentrations ranged from 2.5 to 310 mg/L for the Murray Dam sampling site. The average concentration was 88 mg/L. The period of record was from 1975 until 1986 and included 117 values. Figure 280 shows the chloride data plotted as a function of time.

Coliform. Figure 281 shows the coliform data as a function of time for the period from 1974 until 1986. The record included 138 values. The average coliform count was 85

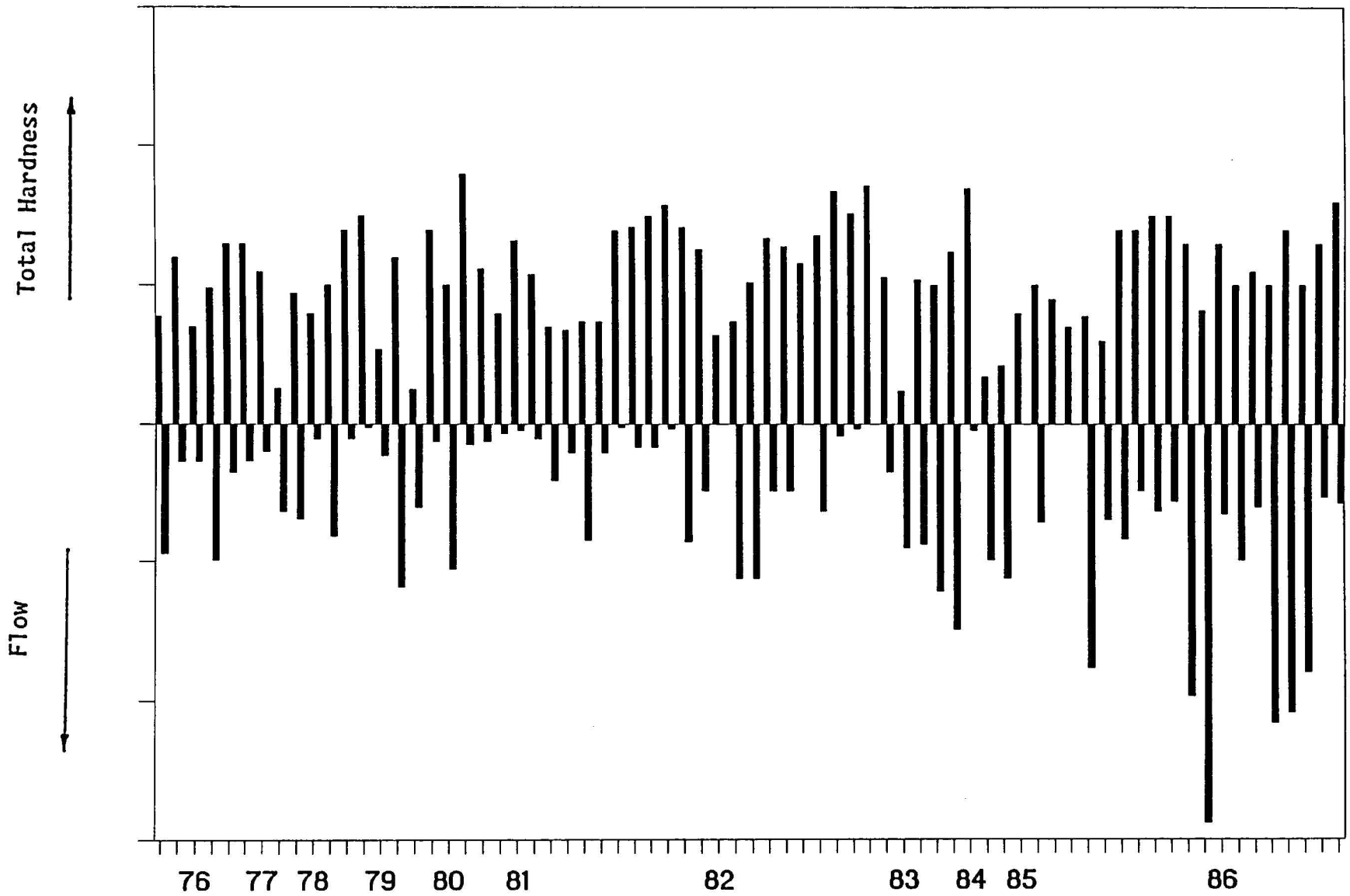

Figure 276. Graph of Total Hardness And Flow Versus Time For The Toad Suck Ferry Lock And Dam Site.

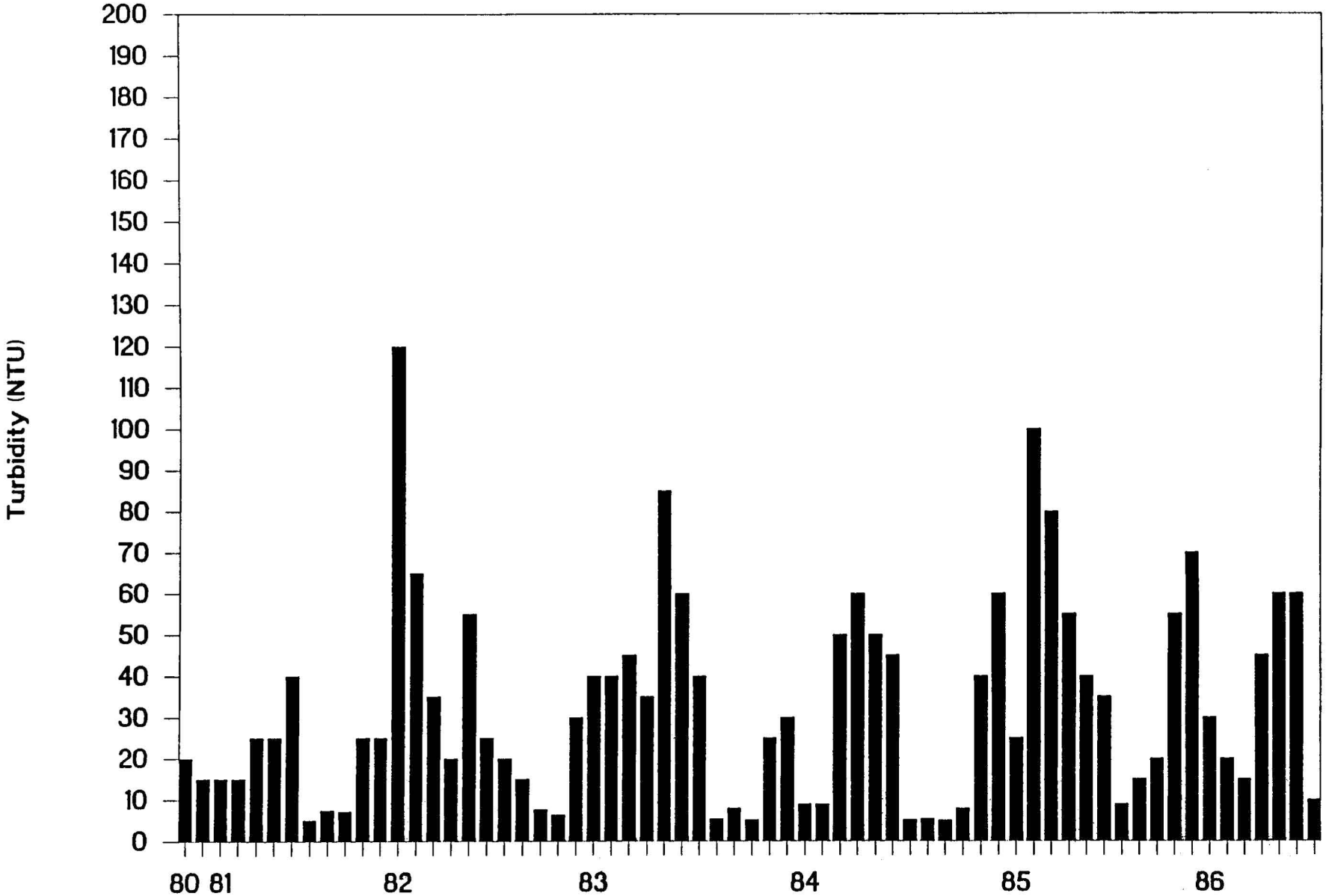

Figure 277. Graph of Turbidity Versus Time For The Toad Suck Ferry Lock And Dam Site.

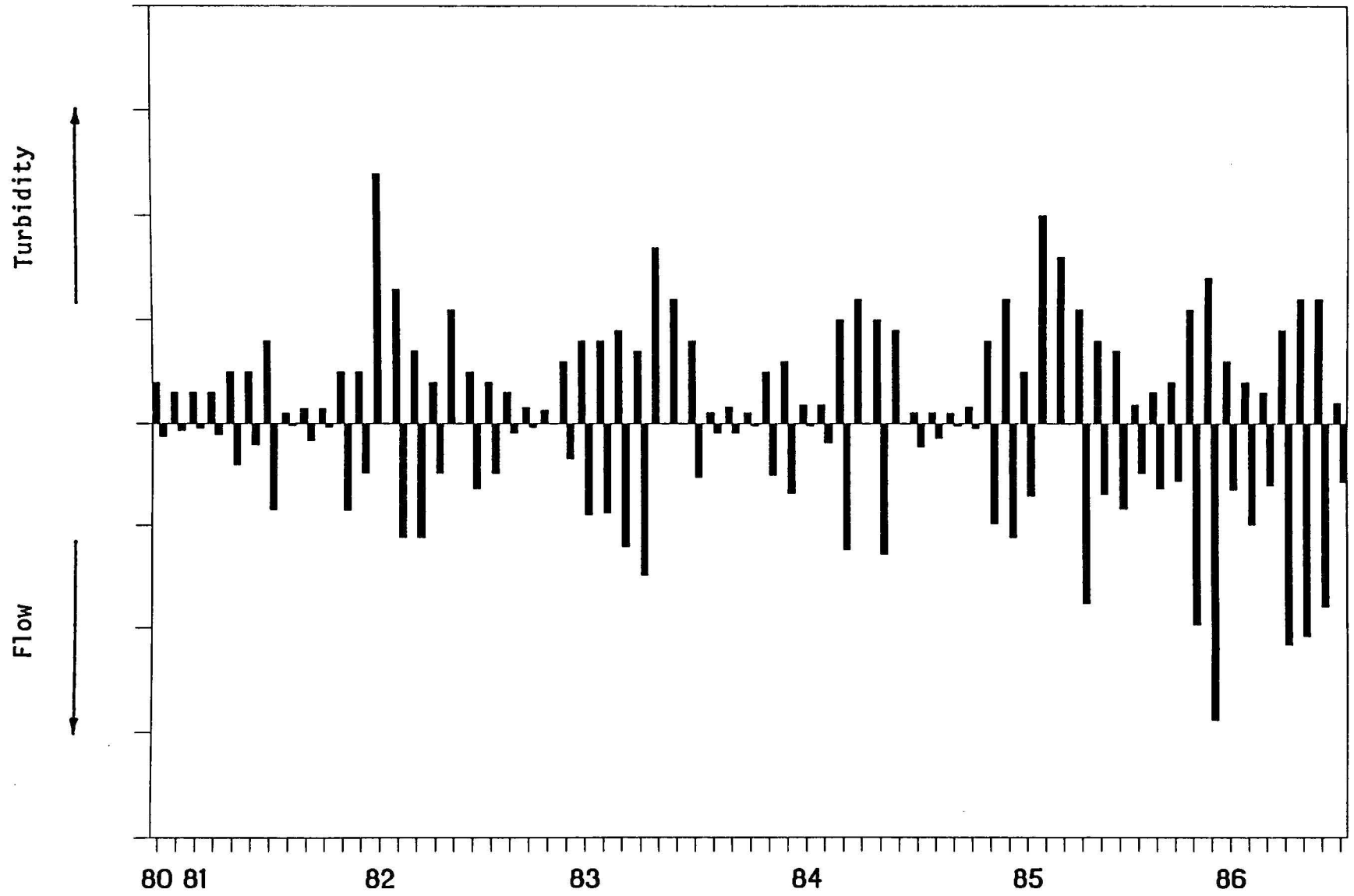

Figure 278. Graph of Turbidity And Flow Versus Time For The Toad Suck Ferry Lock And Dam Site.

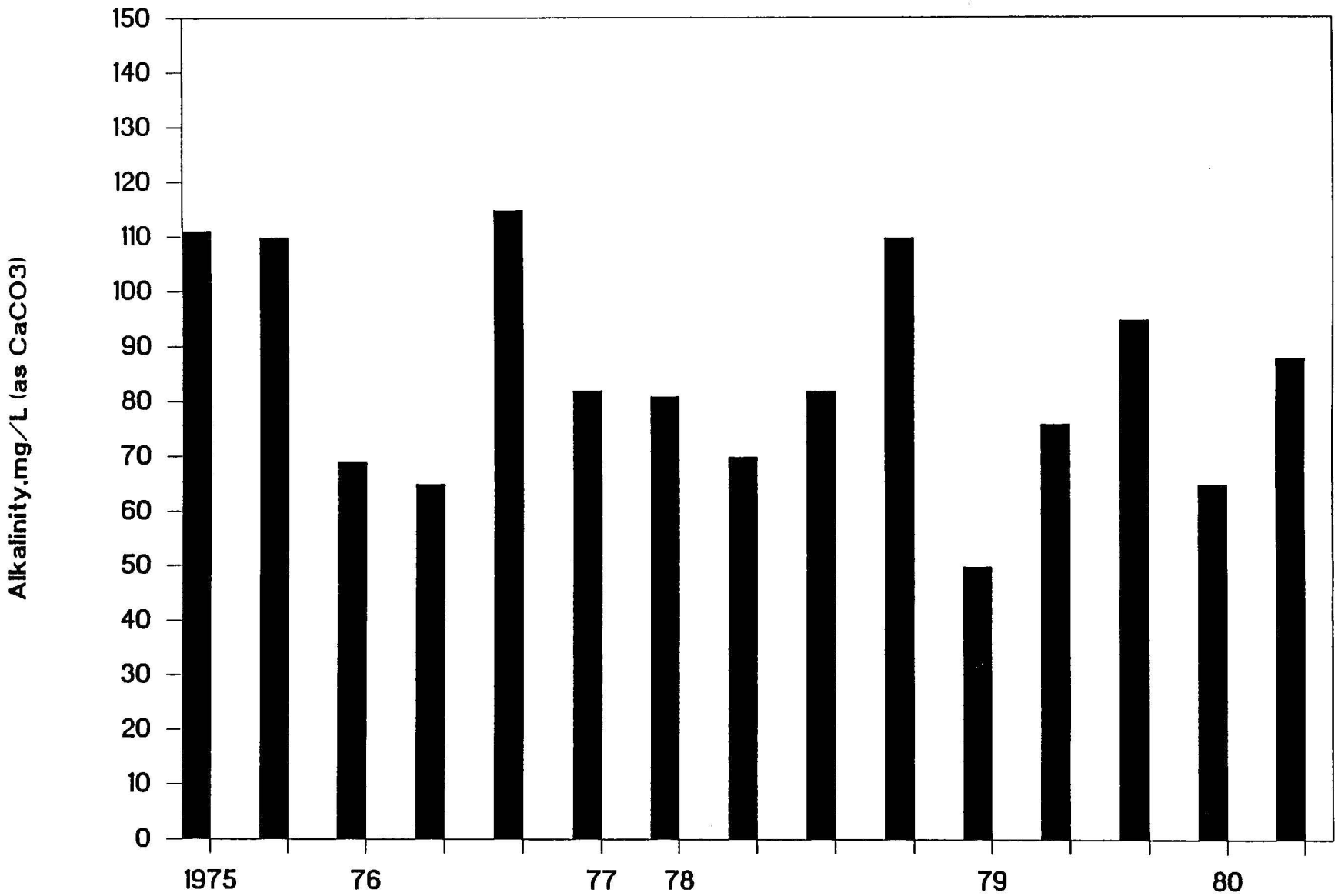

Figure 279. Graph of Alkalinity Versus Flow For The Murray Lock And Dam Site.

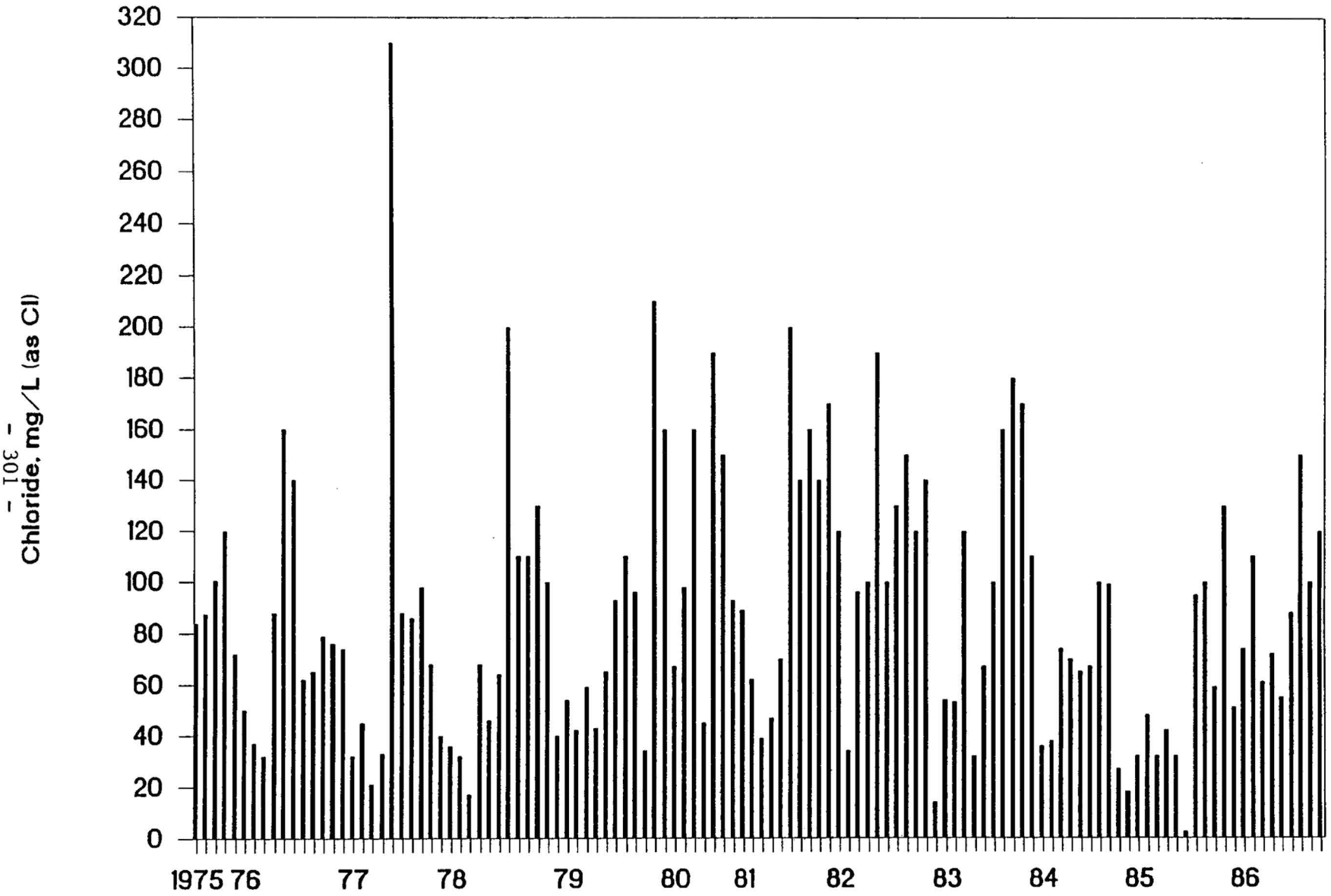

Figure 280. Graph of Chloride Versus Flow For The Murray Lock And Dam Site.

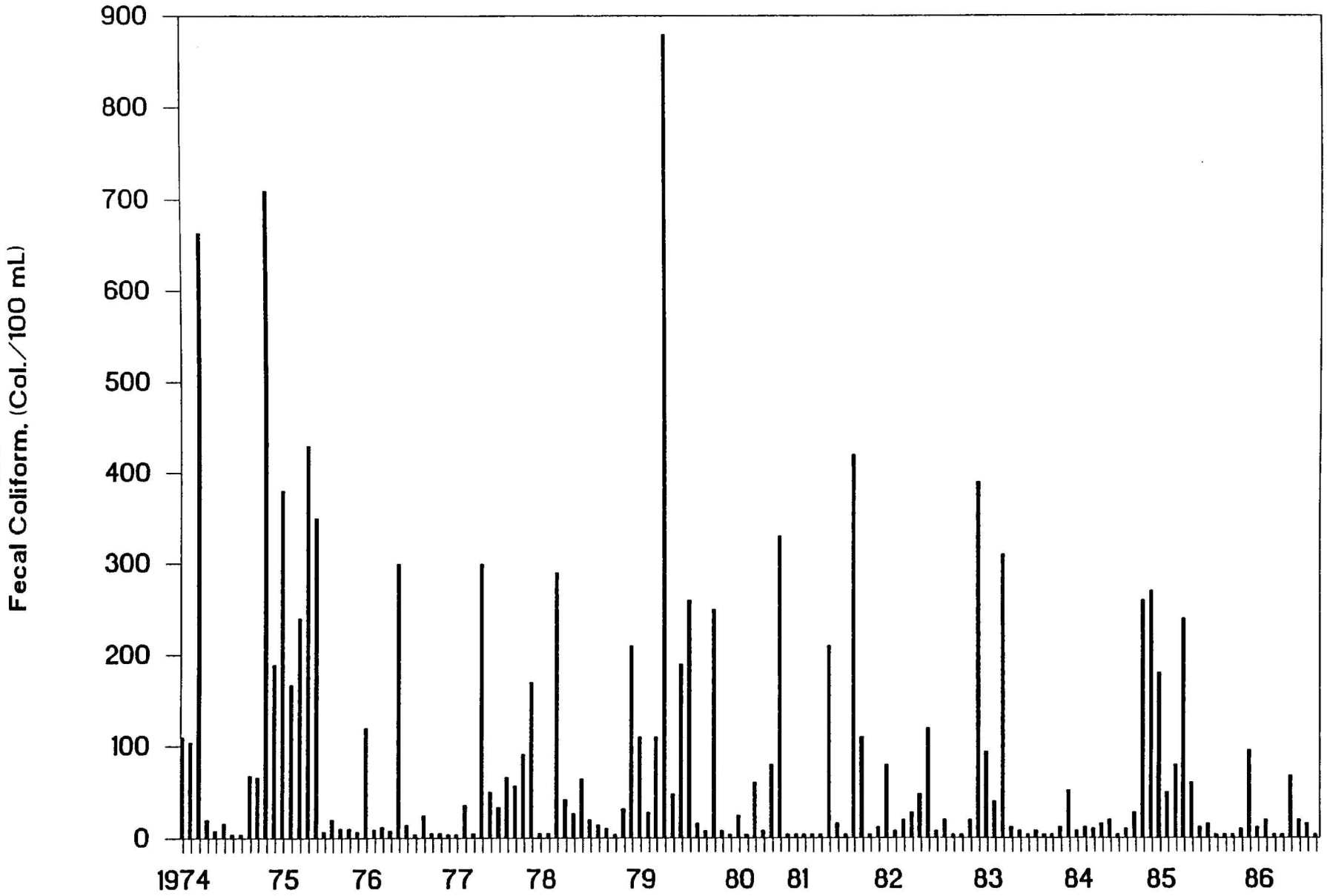

Figure 281. Graph of Coliform Versus Flow For The Murray Lock And Dam Site.

organisms per one hundred milliliters. The minimum and maximum counts were 4 and 880 organisms per one hundred milliliters, respectively.

Calcium. Only seven data points were included in the record. The average concentration was 37 mg/L (as Ca). The minimum and maximum concentrations were 27 and 48 mg/L, respectively.

Dissolved Solids. The minimum and maximum dissolved solids concentrations at this site were 77 and 579 mg/L, respectively. The average concentration was 311 mg/L. The record included 87 values for the period from 1977 until 1986. The data are shown graphically in Figure 282.

pH. The average pH value was 7.9 with the range from 6.7 to 8.7. The record included 129 data points from 1975 until 1986.

David D. Terry Lock And Dam

The period of record for the water quality parameters at the David D. Terry Lock and Dam site was from 1969 until 1987. The site is located at the upper end of the upstream wall at the lock and dam, 10.7 miles downstream from the Main Street bridge at Little Rock. The site is at mile 124.2.

Alkalinity. The average alkalinity concentration at this site was 82 mg/L (as $CaCO_3$). The minimum and maximum concentrations were 36 and 223 mg/L, respectively. The period of record was from 1969 until 1987. The record included 186 concentrations. The alkalinity data are shown in Figure

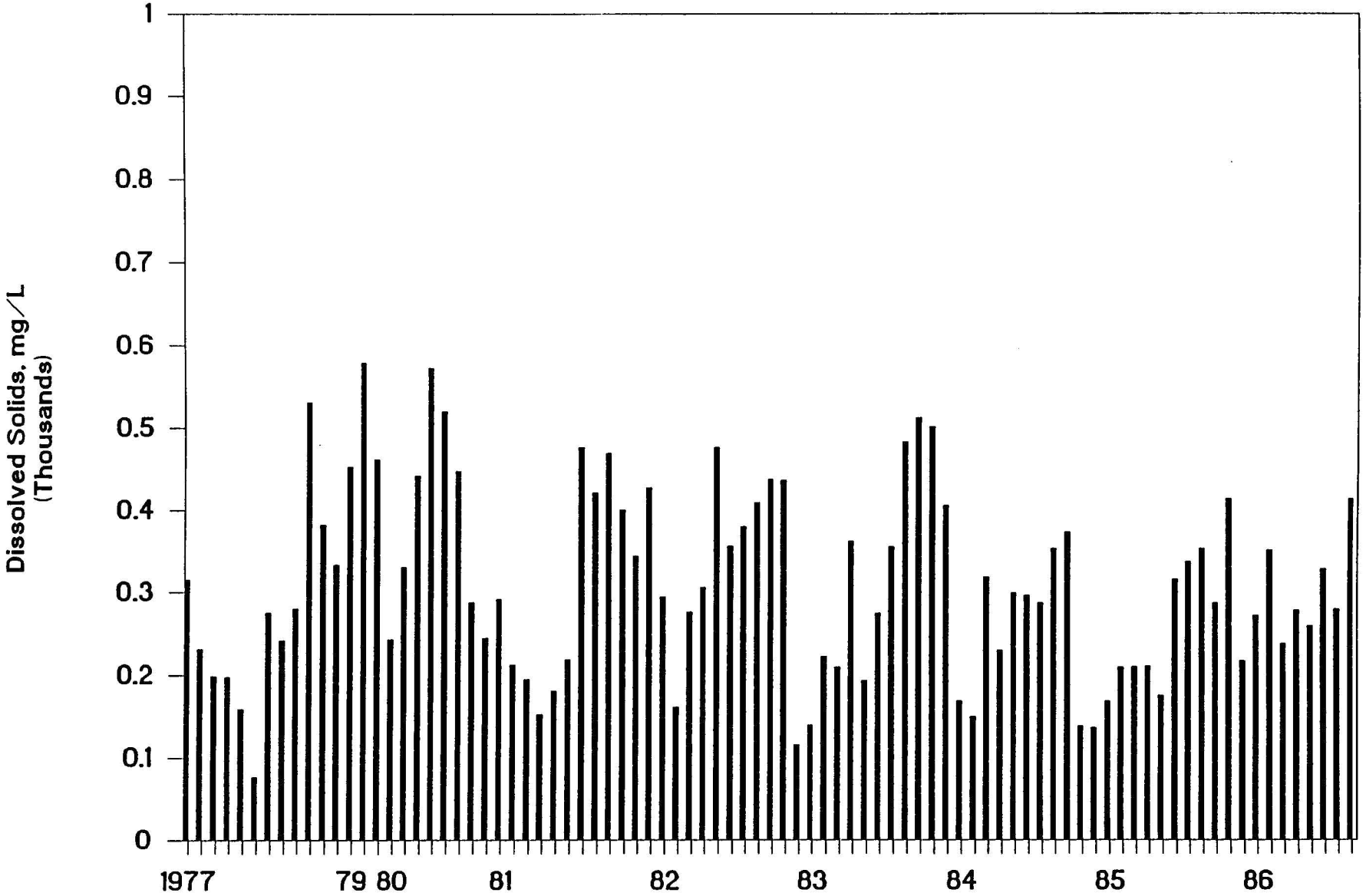

Figure 282. Graph of Dissolved Solids Versus Flow For The Murray Lock And Dam Site.

283. A graph of both flow and alkalinity versus time is included as Figure 284.

Calcium. The calcium concentrations ranged from 12 to 57 mg/L for the David D. Terry Lock and Dam sampling site. The average concentration was 34 mg/L (as Ca). The period of record was from 1969 until 1987 and included 135 values. Figure 285 shows the calcium data plotted as a function of time. A similar graph including both calcium and flow as a function of time is shown in Figure 286.

Coliform. Figure 287 shows the coliform data as a function of time for the period from 1969 until 1976. The record included 79 values. The average coliform count was 44 organisms per one hundred milliliters. The minimum and maximum counts were 1 and 510 organisms per one hundred milliliters, respectively. The coliform and flow data are shown in Figure 288.

Dissolved Solids. The minimum and maximum dissolved solids concentrations at this site were 86 and 600 mg/L, respectively. The average concentration was 302 mg/L. The record included 148 values for the period from 1969 until 1987. The data are shown graphically in Figure 289. Flow and dissolved solids are plotted versus time in Figure 290.

pH. The average pH value was 7.9 units with the range from 6.1 to 9.0 units. The record included 244 data points from 1969 until 1987.

Sodium. The sodium data for the David D. Terry Lock and Dam sampling site averaged 60 mg/L. The minimum and maximum concentrations were 8.5 and 150 mg/L, respectively. The

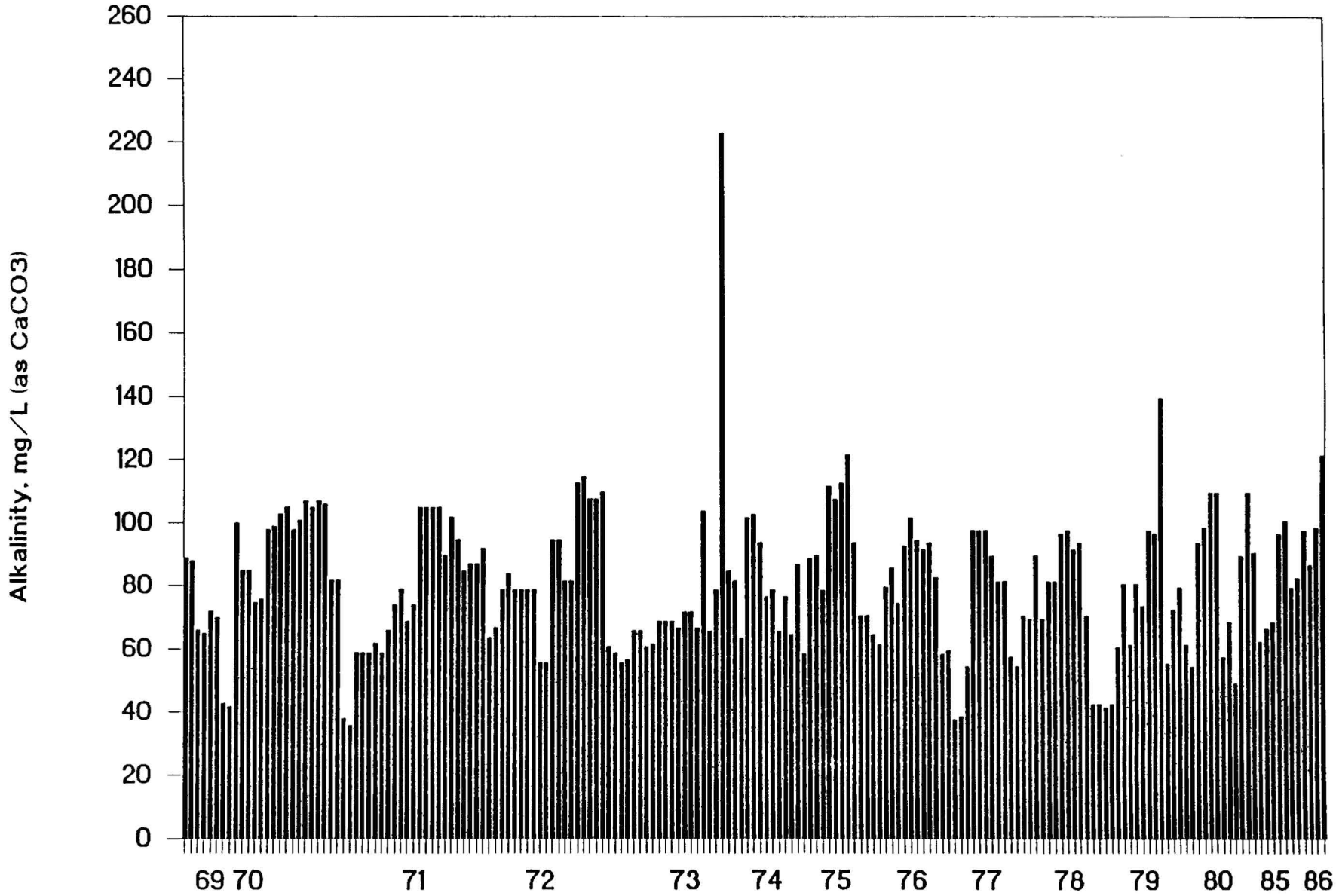

Figure 283. Graph of Alkalinity Versus Time For The David D. Terry Lock And Dam Site

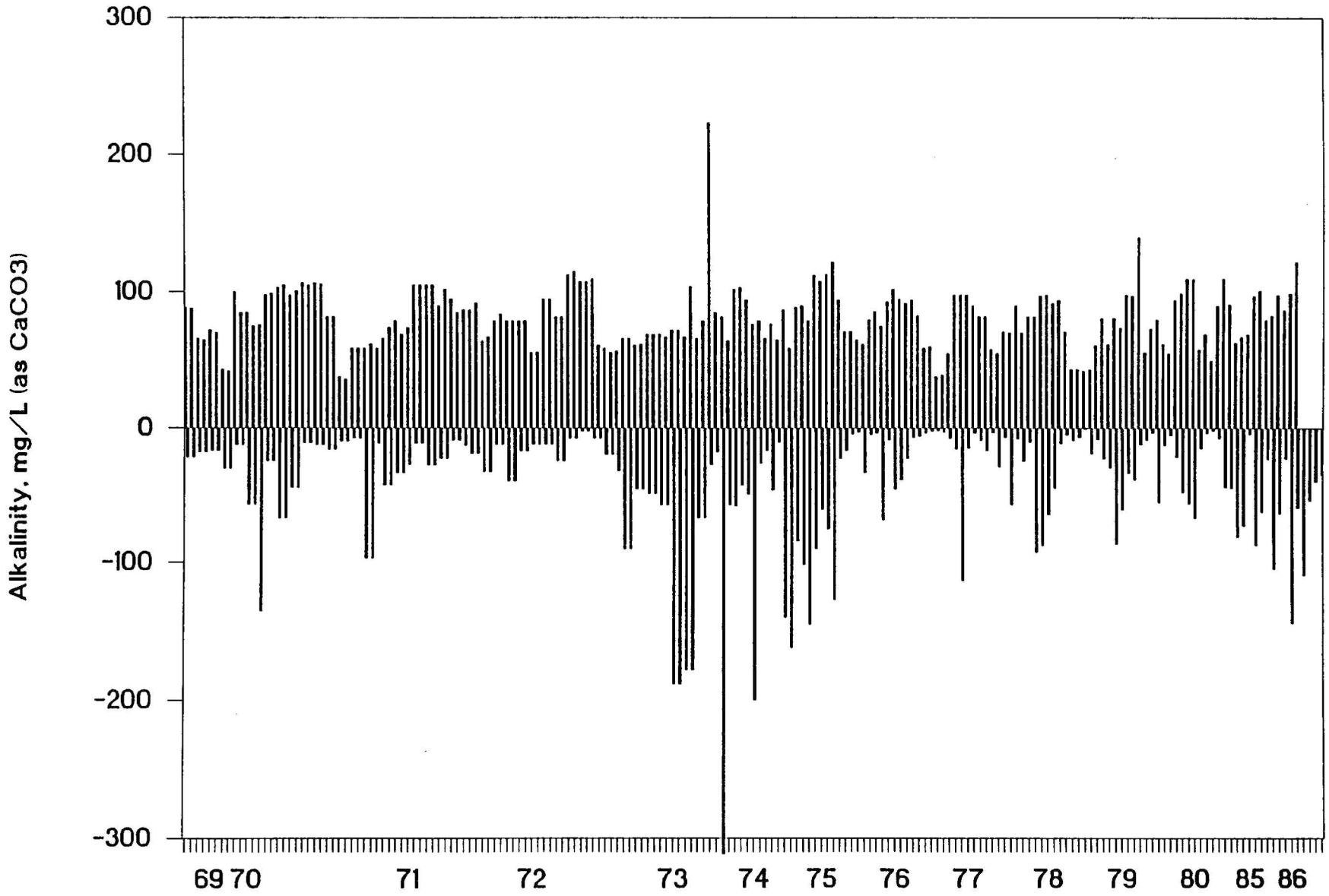

Figure 284. Graph of Alkalinity And Flow Versus Time For The David D. Terry Lock And Dam Site

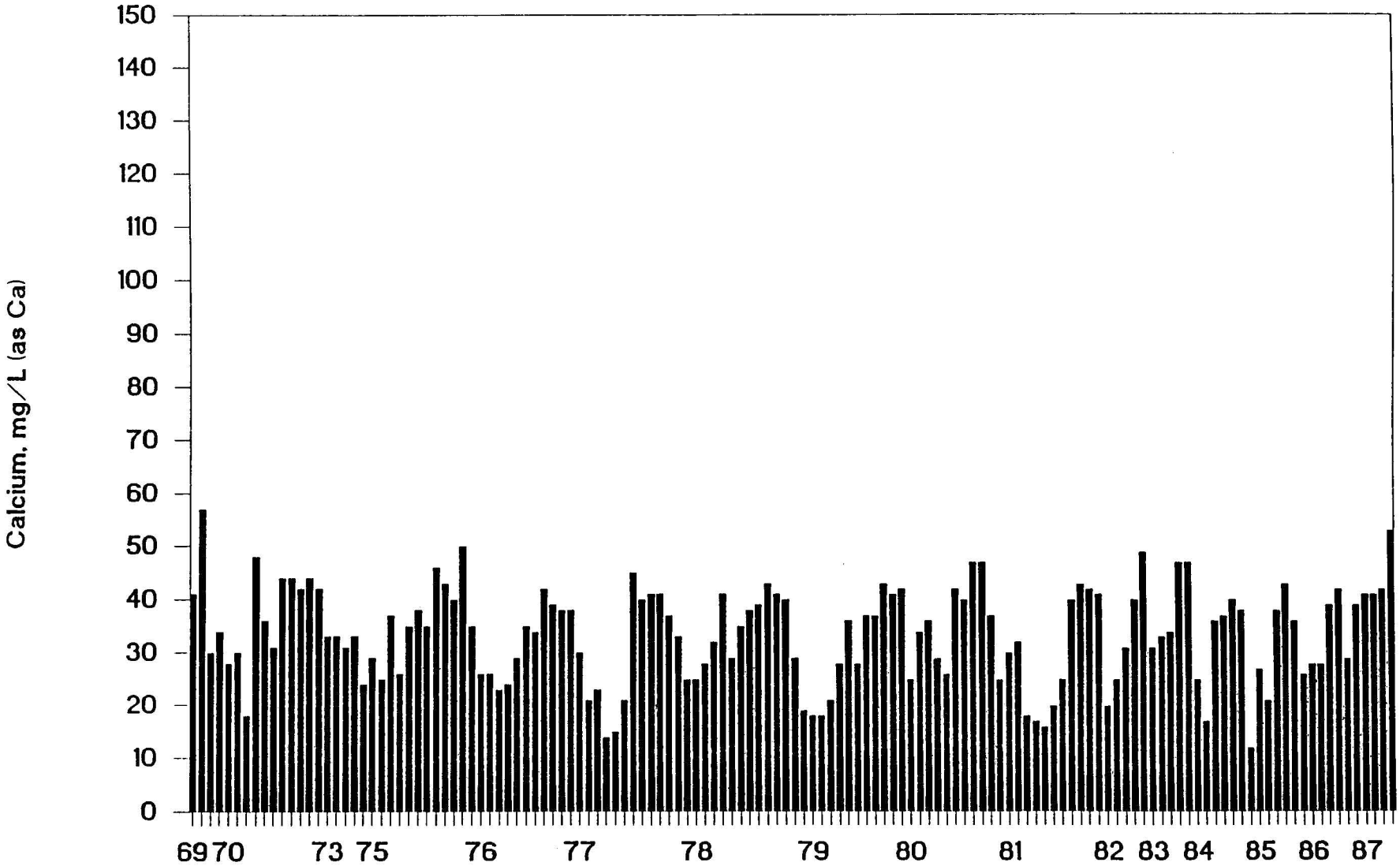

Figure 285. Graph of Calcium Versus Time For The David D. Terry Lock And Dam Site

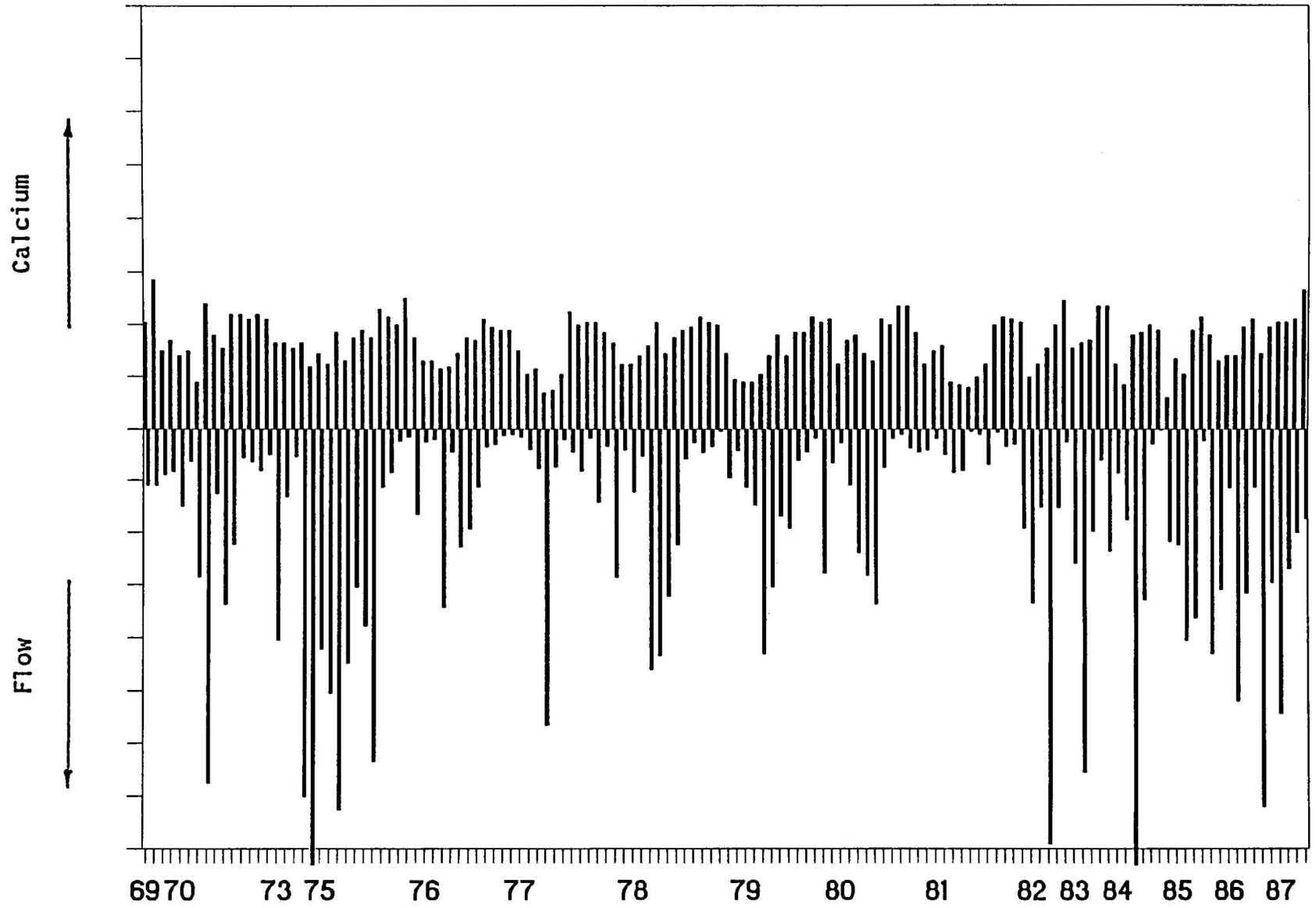

Figure 286. Graph of Calcium And Flow Versus Time For The David D. Terry Lock And Dam Site

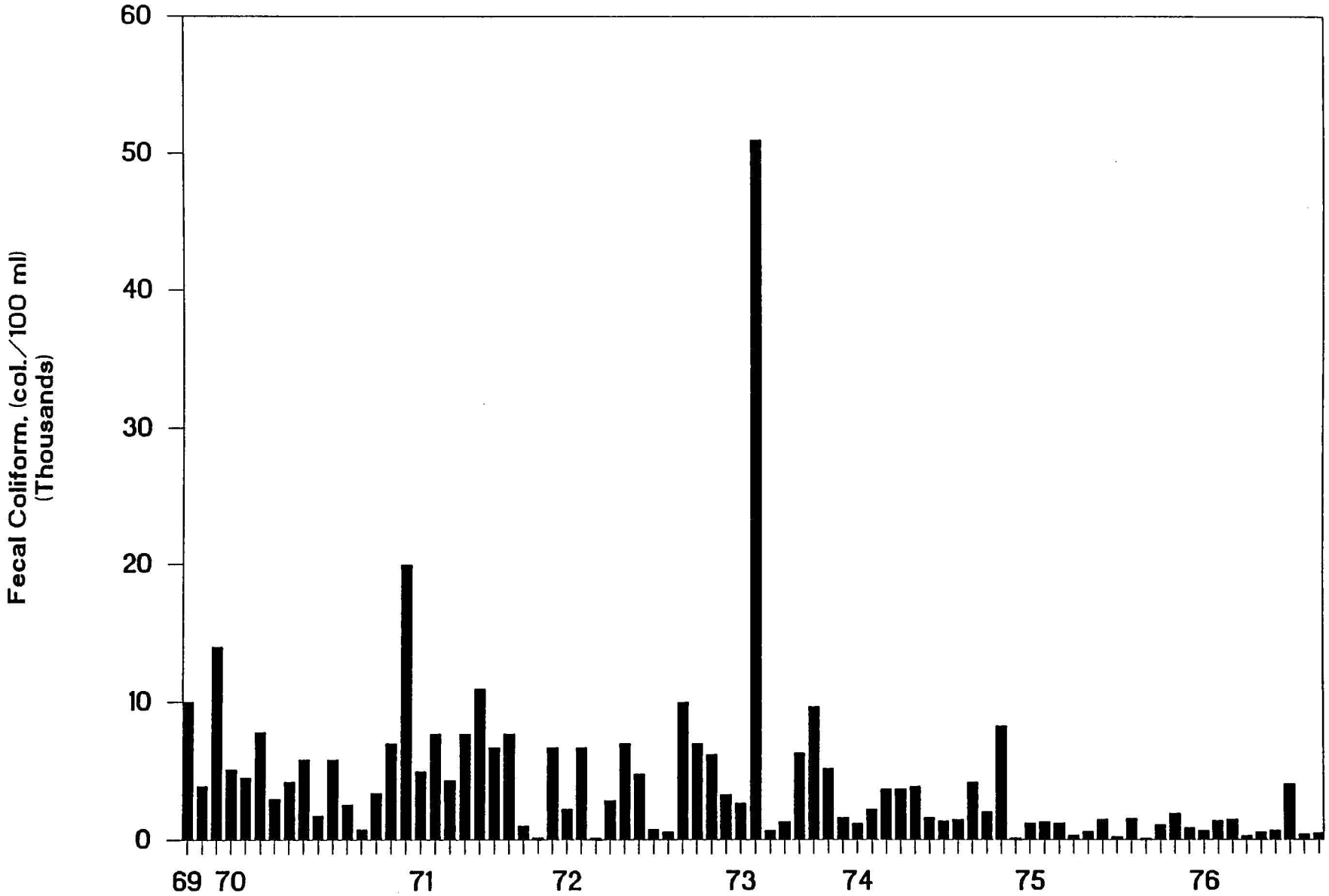

Figure 287. Graph of Coliform Versus Time For The David D. Terry Lock And Dam Site

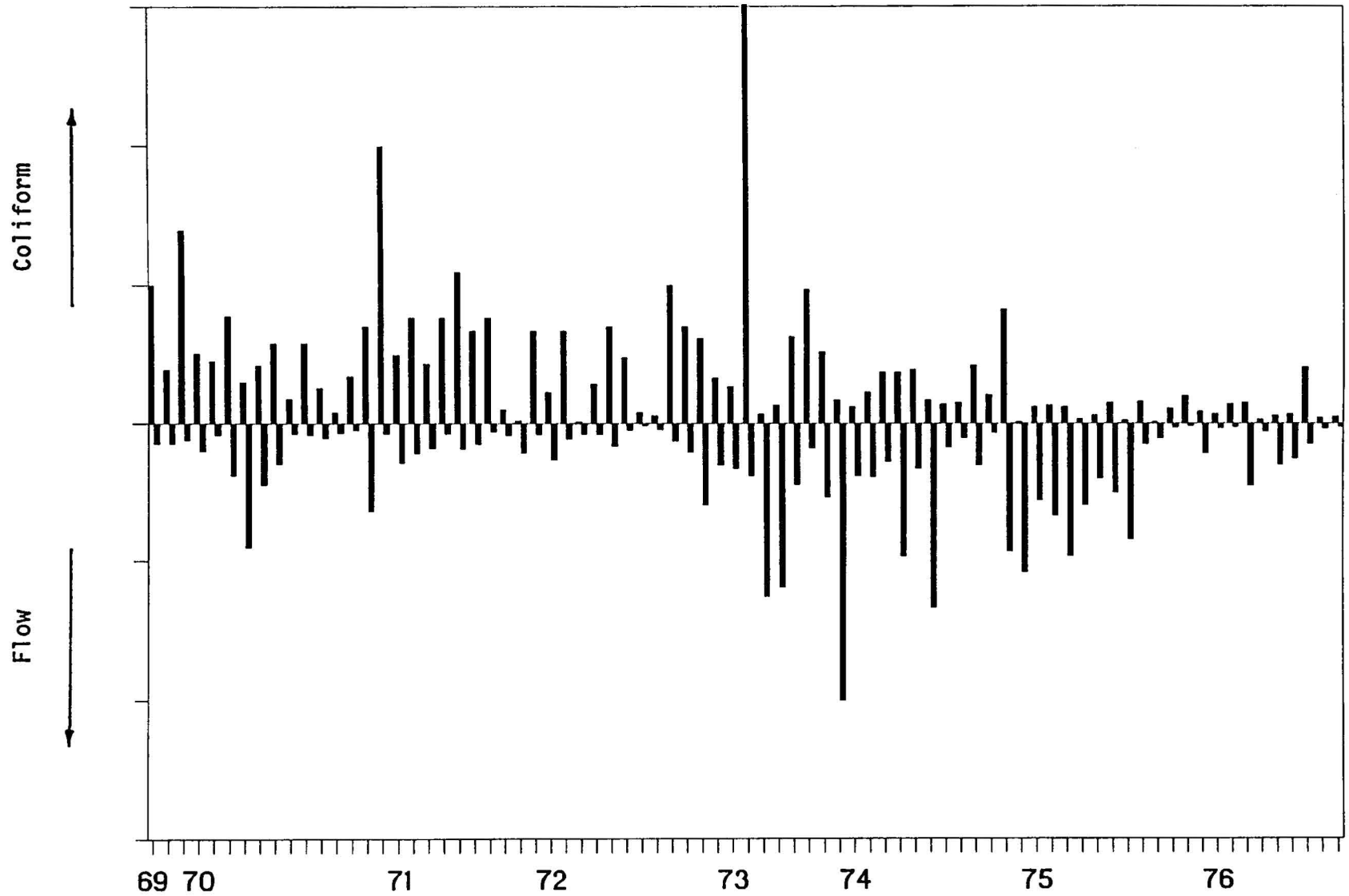

Figure 288. Graph of Coliform And Flow Versus Time For The David D. Terry Lock And Dam Site

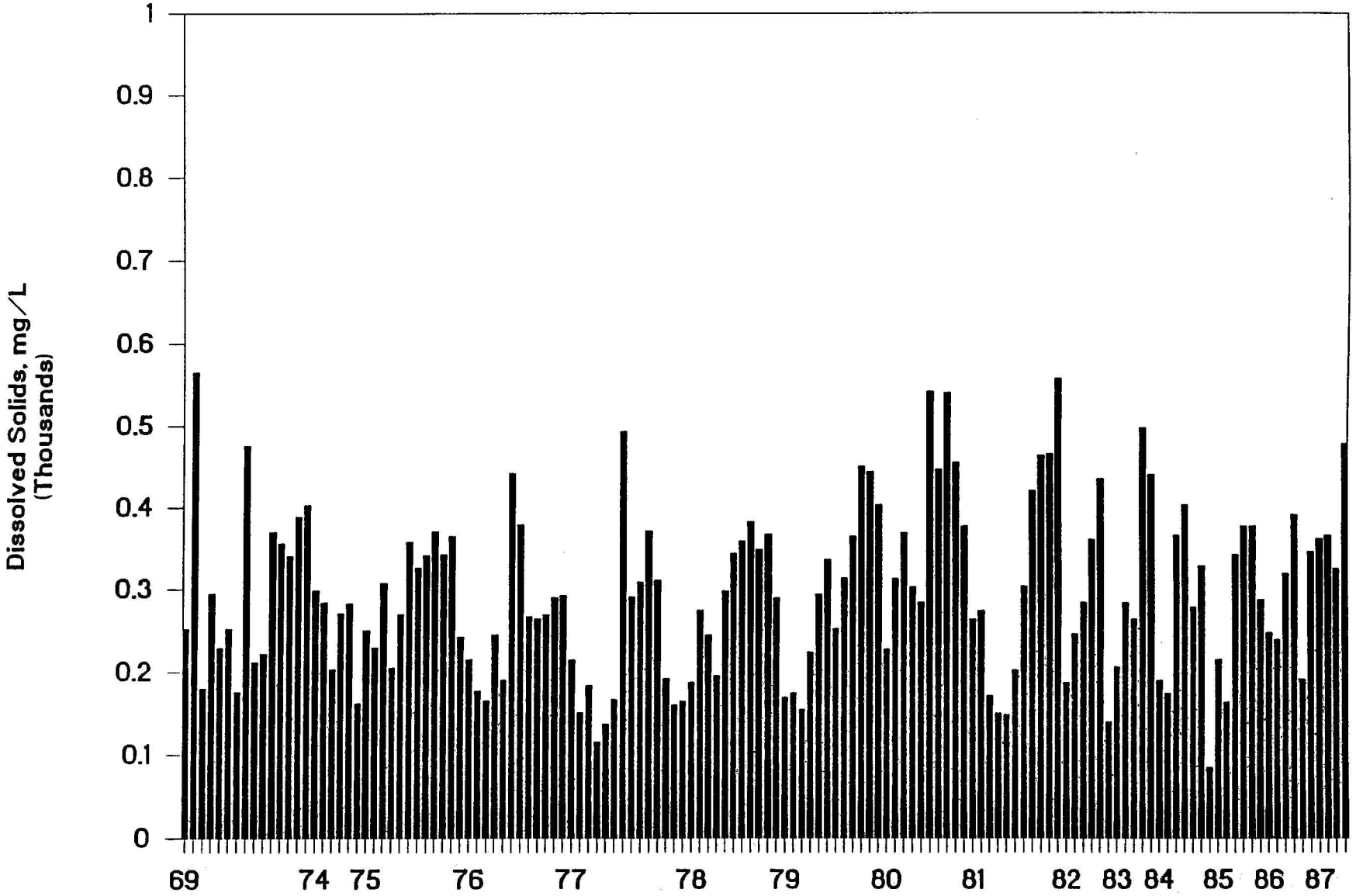

Figure 289. Graph of Dissolved Solids Versus Time For The David D. Terry Lock And Dam Site

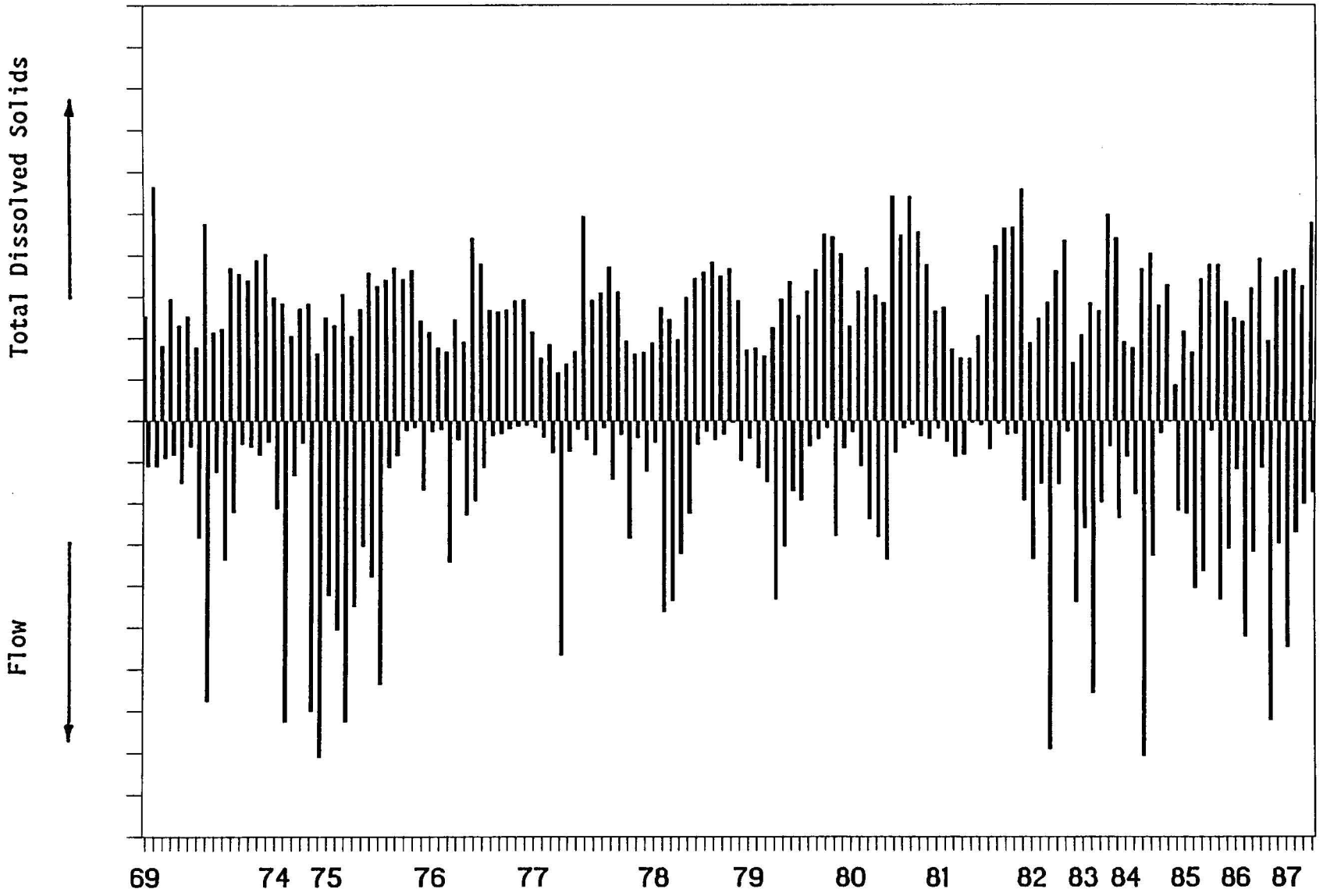

Figure 290. Graph of Dissolved Solids And Flow Versus Time For The David D. Terry Lock And Dam Site

record included 136 sodium concentrations for the period from 1969 until 1987. Figure 291 provides a graphical illustration of the sodium data as a function of time. Both flow and sodium are plotted versus time in Figure 292.

Suspended Solids. The suspended solids concentrations ranged from 4 to 260 mg/L at this site. The average concentration was 51 mg/L. The record included 25 concentrations for the period from 1969 until 1978. Figure 293 shows the data versus time for this parameter.

Sulfate. The average sulfate concentration at the David D. Terry Lock and Dam sampling site was 39 mg/L. The minimum and maximum concentrations were 14 and 90 mg/L, respectively. One hundred and seventy concentrations for the period from 1969 until 1987 were included in the record. The data are shown graphically in Figure 294. Both flow and sulfate are shown as a function of time in Figure 295.

Total Hardness. The total hardness concentrations in the river water at the David D. Terry Lock and Dam sampling site averaged 113 mg/L. The data are shown in Figure 296. The minimum and maximum concentrations were 51 and 187 mg/L, respectively. The record for the period from 1969 until 1987 included 144 concentrations. A graph of flow and total hardness versus time is included as Figure 297.

Turbidity. The turbidity at this site ranged from 1.5 to 660 turbidity units. The average value was 30 units. Figure 298 shows the turbidity data for this site. The record included 76 values for the period from 1978 until 1987. Turbidity and flow are plotted versus time in Figure 299.

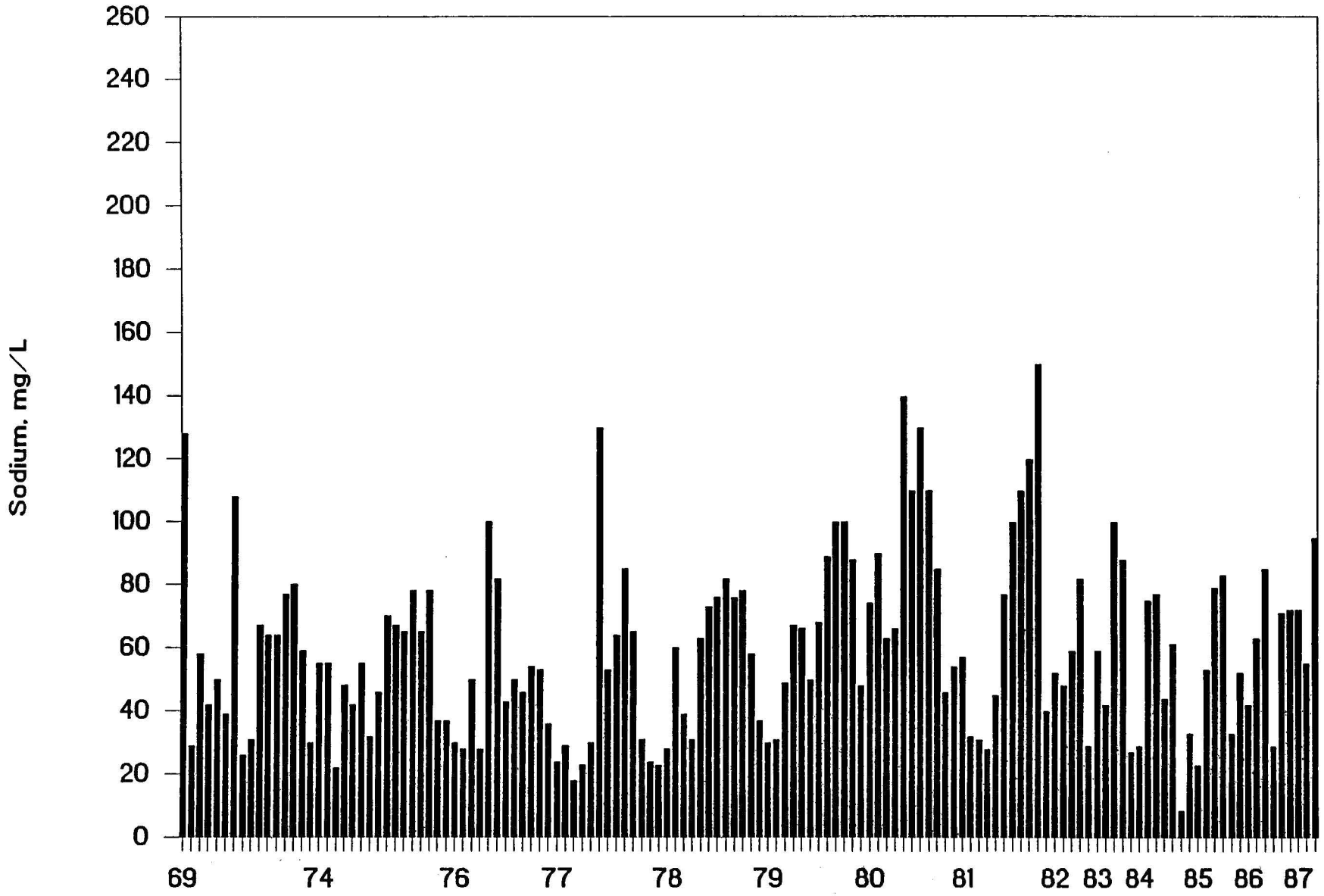

Figure 291. Graph of Sodium Versus Time For The David D. Terry Lock And Dam Site

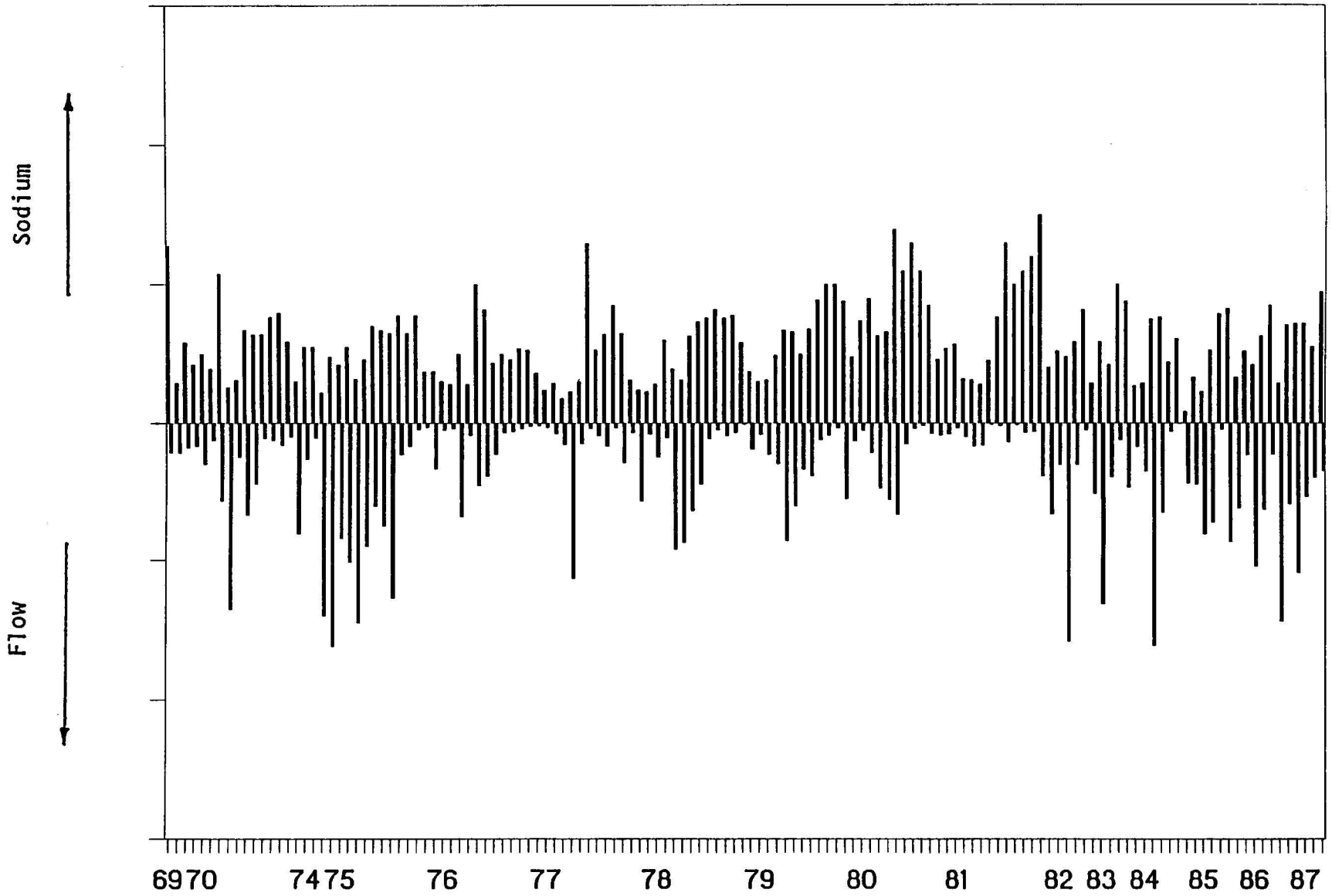

Figure 292. Graph of Sodium And Flow Versus Time For The David D. Terry Lock And Dam Site

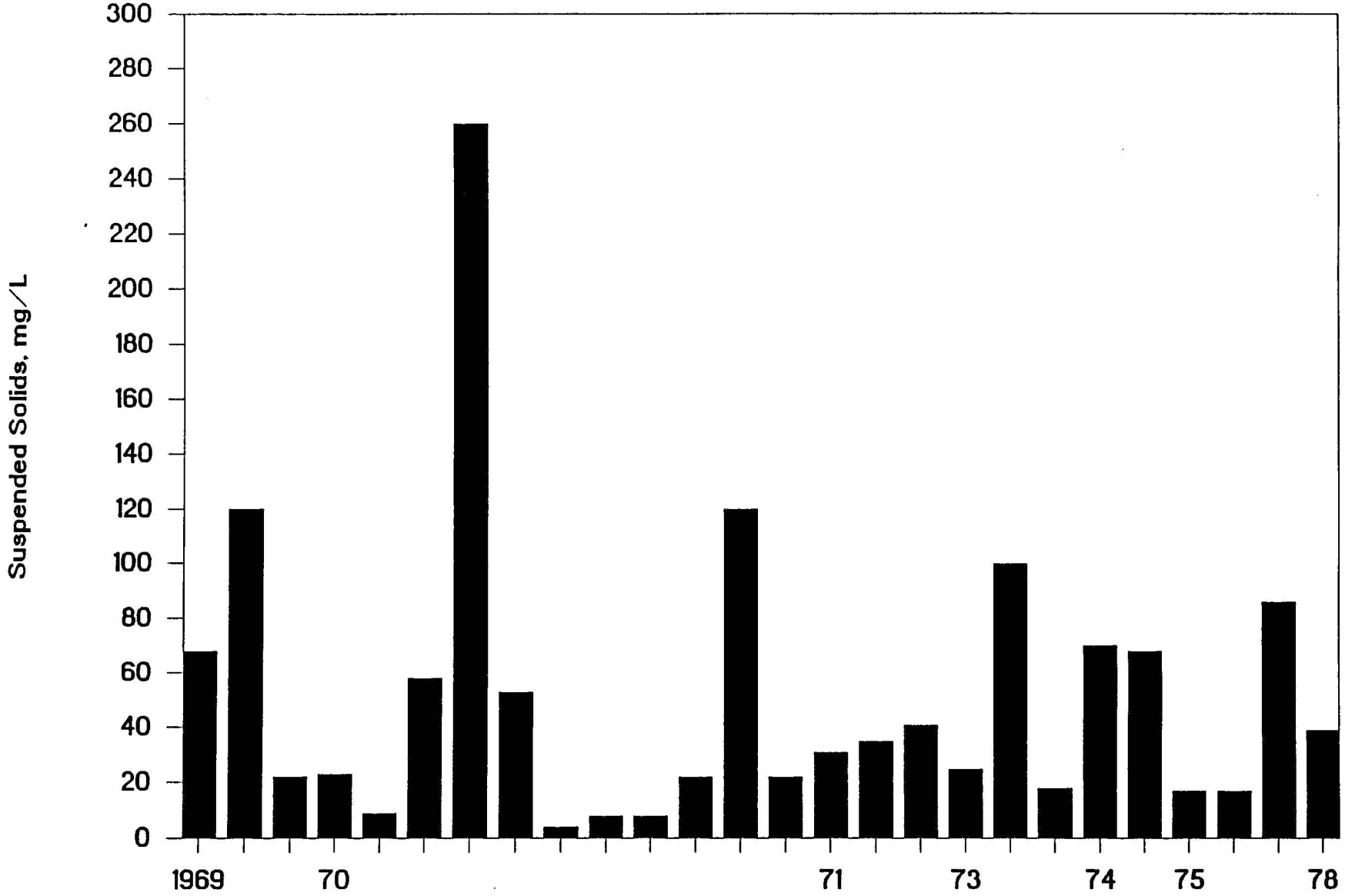

Figure 293. Graph of Suspended Solids Versus Time For The David D. Terry Lock And Dam Site

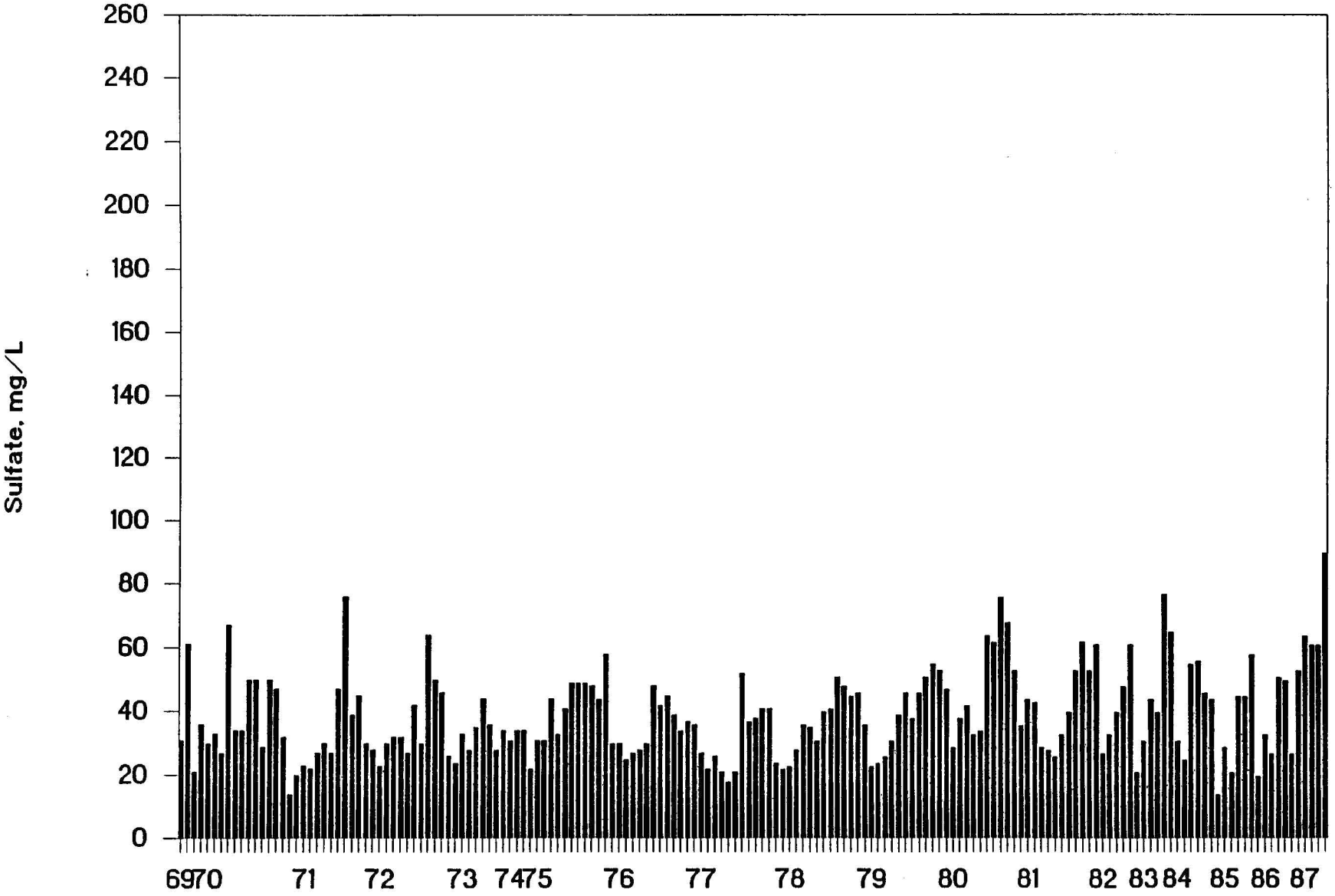

Figure 294. Graph of Sulfate Versus Time For The David D. Terry Lock And Dam Site

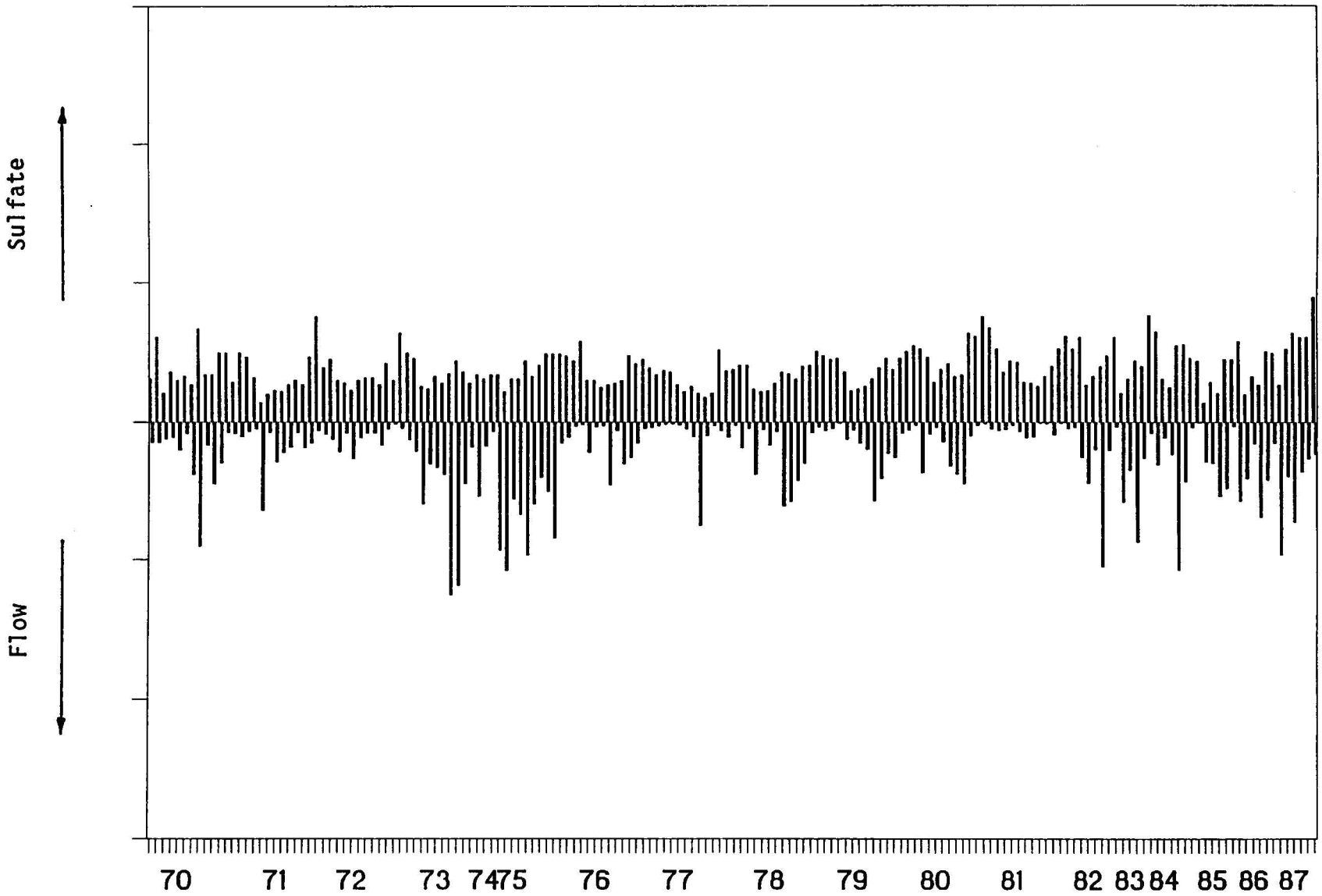

Figure 295. Graph of Sulfate And Flow Versus Time For The David D. Terry Lock And Dam Site

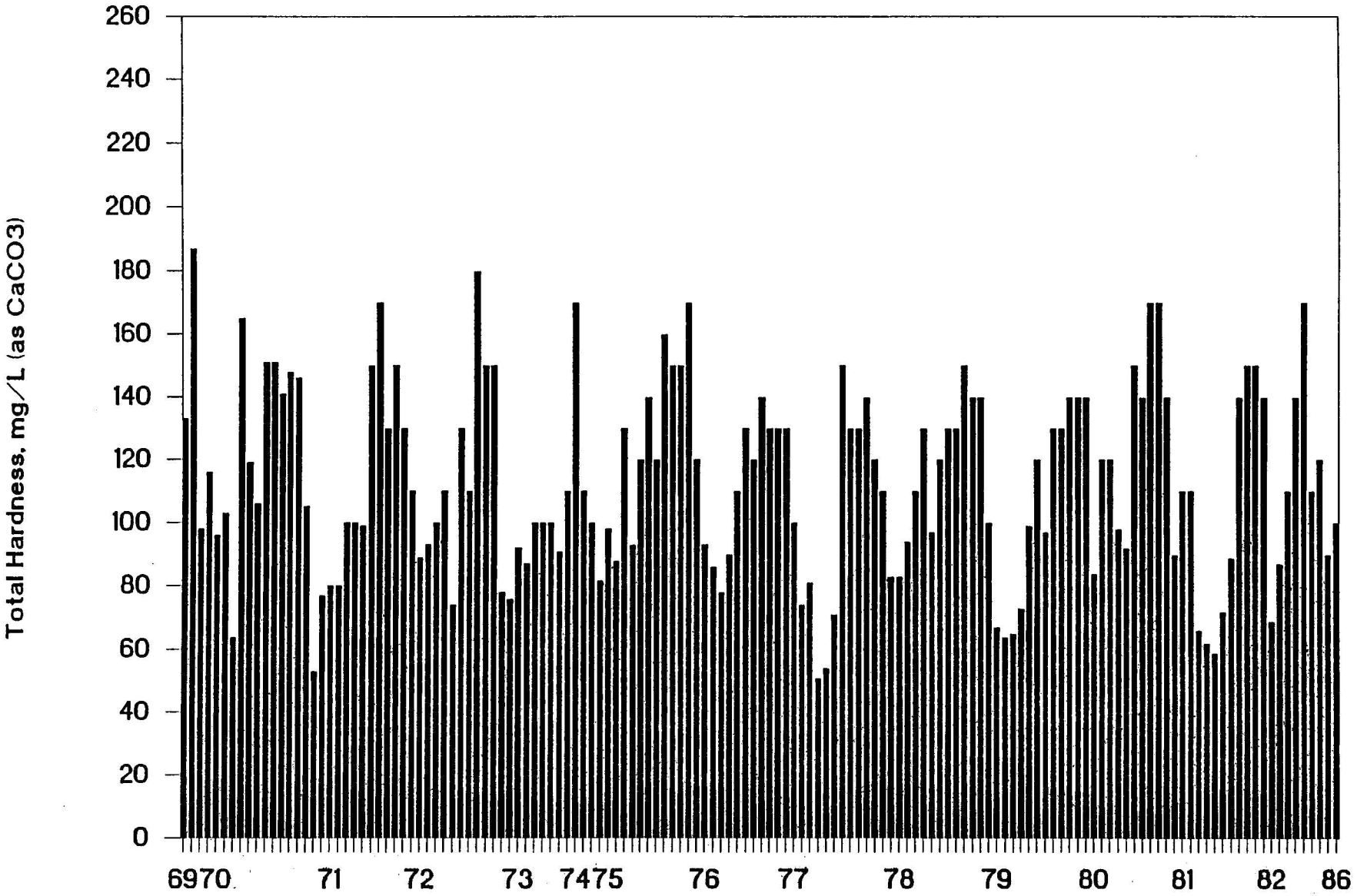

Figure 296. Graph of Total Hardness Versus Time For The David D. Terry Lock And Dam Site

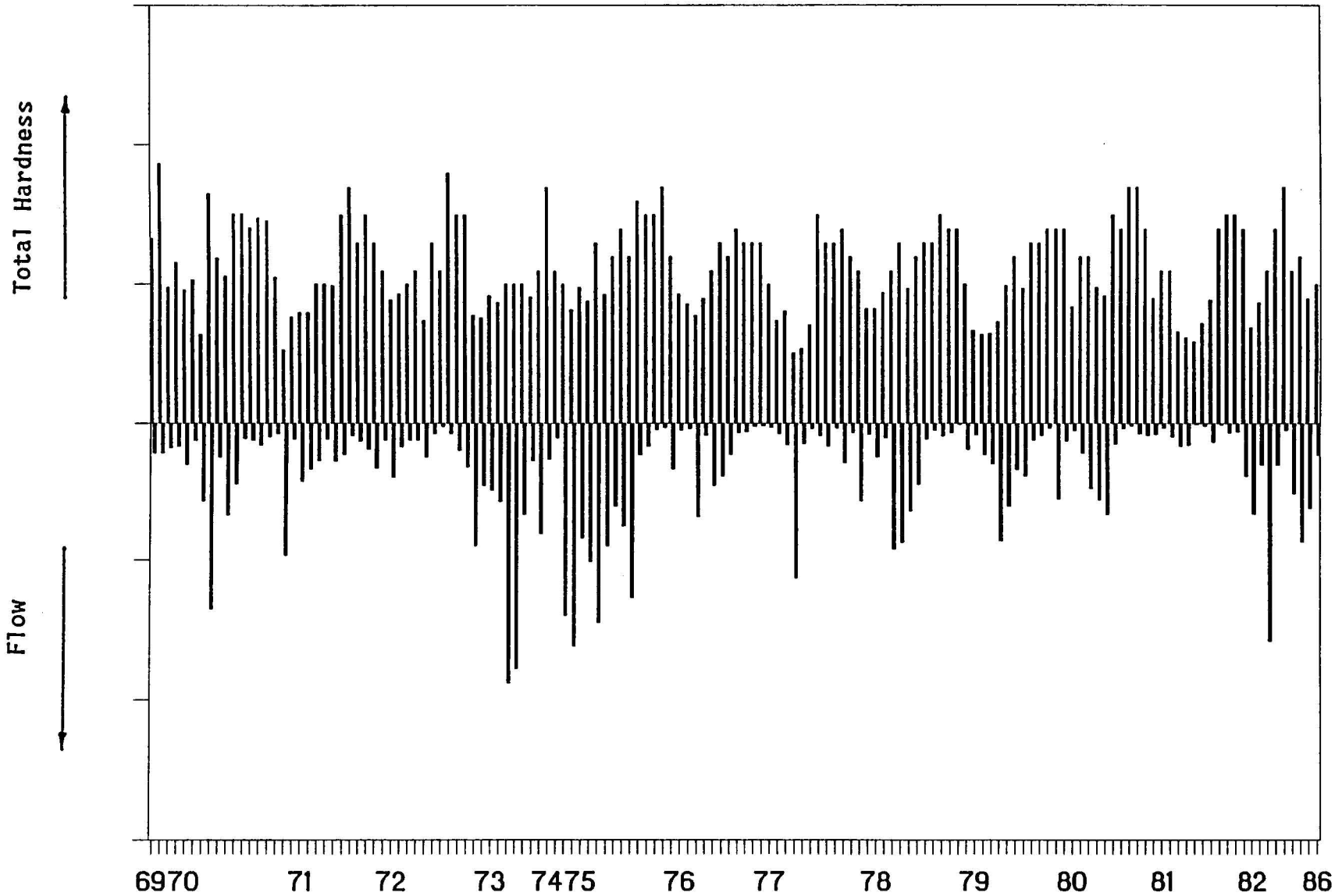

Figure 297. Graph of Total Hardness And Flow Versus Time For The David D. Terry Lock And Dam Site

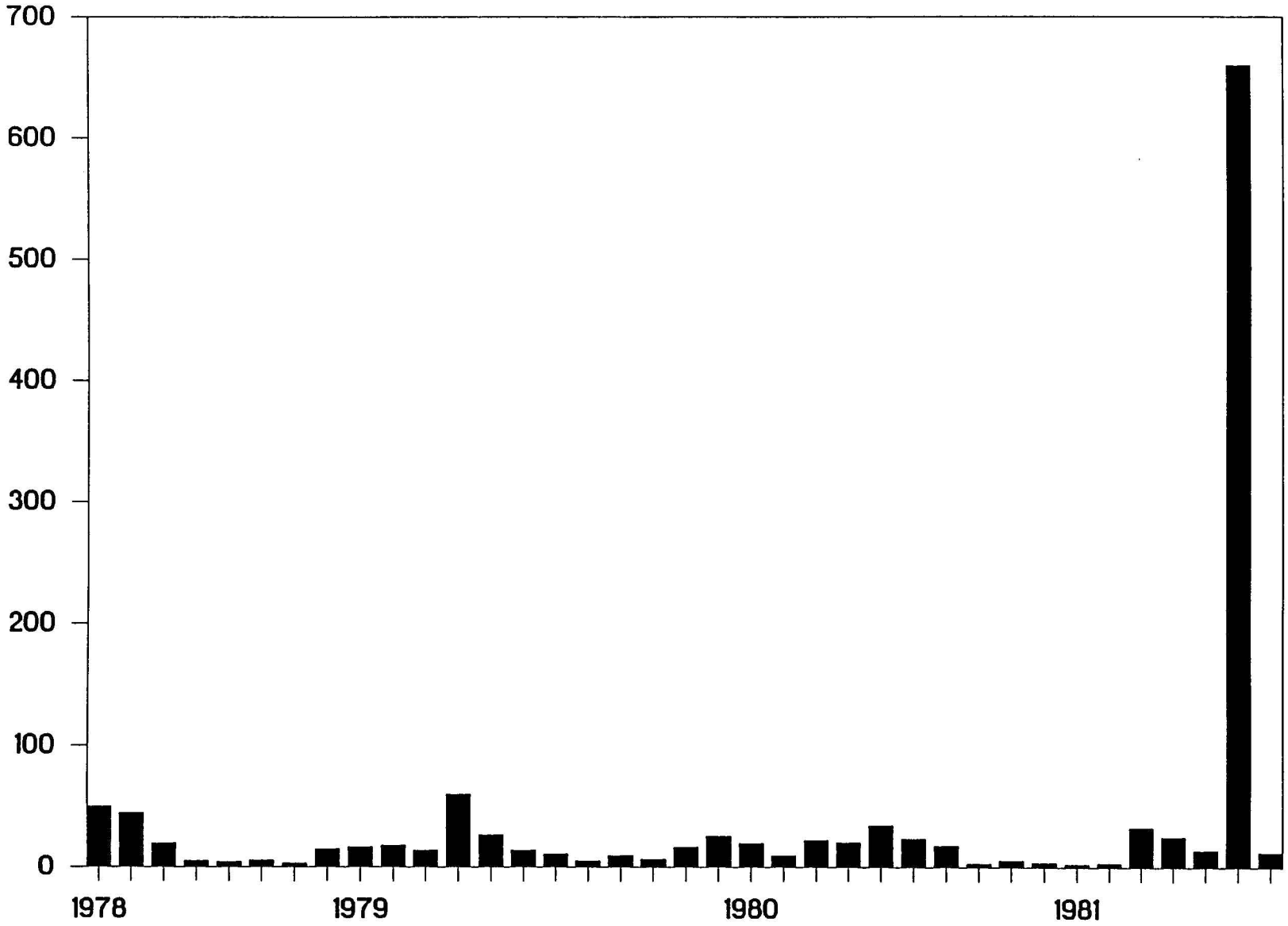

Figure 298. Graph of Turbidity Versus Time For The David D. Terry Lock And Dam Site